



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

EPA Region 5 Records Ctr.



203049

OCT 27 2003

REPLY TO THE ATTENTION OF:

S-6J

Commander
Southern Division
Naval Facilities Engineering Command
Attn: CAPTAIN PAUL McMAHON, JR.
Code 00
P.O. Box 190010
North Charleston, SC 29419-9010

**RE: Naval Industrial Reserve Ordnance Plant (NIROP), Fridley, Minnesota
Five-Year Review Report**

Dear Captain McMahon:

U.S. Environmental Protection Agency (EPA) has reviewed the Five-Year Review Report dated October 2003, developed by TETRA TECH NUS, Inc. for the Department of Navy (Navy) and transmitted via an e-mail correspondence on October 27, 2003. EPA concurs with the Navy's conclusion that the Remedy for Operable Unit 1 remains protective and the Remedy requiring Land Use Controls for Operable Unit 2 and Operable Unit 3 signed in September 2003 will be evaluated in the next Five-Year Review. It is EPA's understanding that the State of Minnesota also plans to concur with the Navy's conclusions.

EPA remains committed to working with the Navy in implementing the recommendations and follow-up actions and addressing the current issues identified by this review. It is EPA's understanding that the Navy will sign this report and provide printed copies to the regulatory agencies for inclusion in EPA's site files.

If you have any questions or concerns, please contact David Seely of my staff at (312) 886-7058.

Sincerely,

for William E. Muno, Director
Superfund Division

cc: David Douglas, MPCA

**Five Year Review
Operable Unit (OU) 1**

**Naval Industrial Reserve
Ordnance Plant
Fridley, Minnesota**



**Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0284**

October 2003

**FIVE YEAR REVIEW
OPERABLE UNIT (OU) 1**

**NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT (NIROP)
FRIDLEY, MINNESOTA**

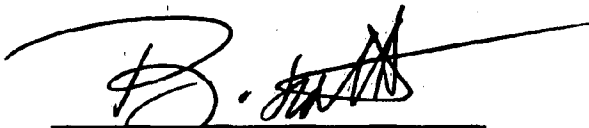
**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406**

**Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220**

**CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0284**

OCTOBER 2003



**CAPT. BRIAN SCOTT
VICE-COMMANDER, SOUTHERN DIVISION, NAVFAC**

10 / 31 / 2003
DATE

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FIGURES

NUMBER

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LIST OF ACRONYMS AND ABBREVIATIONS

ACL	alternative concentration limit
ACP	Anoka County Park
AER	air emission rate
AMR	Annual Monitoring Report
AOC	area of concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DCA	dichloroethane
DCE	dichloroethene
DQO	data quality objective
EPA	Environmental Protection Agency
FFA	Federal Facilities Agreement
FMC	FMC Corporation
FS	Feasibility Study
GAC	granular activated carbon
gpm	gallons per minute
GWTF	groundwater treatment facility
IAS	Initial Assessment Study
IR	Installation Restoration
LUC	land use control
MCL	Maximum Contaminant Level (USEPA)
MDH	Minnesota Department of Health
mg/L	milligram per liter
µg/kg	microgram per kilogram
µg/L	microgram per liter
ug/m ³	microgram per cubic meter
ug/sec	microgram per second
MPCA	Minnesota Pollution Control Agency
NACIP	Navy Assessment and Control of Installation Pollutants
NAVFACENGCOM	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Contingency Plan

NIROP	Naval Industrial Reserve Ordnance Plant
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
O&M	operation and maintenance
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCE	tetrachloroethene
PCJ	Prairie du Chien/Jordan aquifer
PID	photo-ionization detector
RAB	Restoration Advisory Board
RAMP	Remedial Action Monitoring Plan
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SDS	State Disposal System
SWMU	Solid Waste Management Unit
TCA	trichloroethane
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TRC	Technical Review Committee
TtNUS	Tetra Tech NUS, Inc.
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UDLP	United Defense Limited Partnership
USGS	U.S. Geological Survey
VOC	volatile organic compound
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

Three operable units (OUs) have been identified at NIROP Fridley. Groundwater is identified as Operable Unit 1. The land outside of the main NIROP manufacturing building but within the legal boundaries of the facility, from ground surface down to groundwater elevation, has been identified as OU2. The land underneath the main NIROP building, and soils at elevations below groundwater elevation (the saturated zone) either under the building or outside the building, but within the legal boundaries of the facility has been designated as OU3. The Record of Decision (ROD) for OU1 was signed in September 1990, and the first Five Year Review for OU1 was signed in September 1998. The ROD for OU2 and OU3 is combined into a single document, and was signed in September, 2003. The selected remedy for both OU2 and OU3 is Land Use Controls. Additional chronology details are provided in Section 2 of this Five Year Review.

The groundwater remedy for Naval Industrial Reserve Ordnance Plant (NIROP) Fridley in Fridley, Minnesota included installation and operation of ground water and recovery wells, with a two-phased plan for disposal of the ground water from the system. The sight achieved construction completion in August 1991. The trigger for this second five year review was the last signature date of the first Five Year Review on October 27, 1998.

The assessment of this Five Year Review found that the remedy was constructed in accordance with the requirements of the OU 1 Record of Decision. The remedy is functioning as designed. The immediate threats have been addressed and the remedy is protective.

The previous Five Year Review identified that contaminated ground water conditions in Anoka County Park were not dissipating as anticipated in the ROD which may allow for the continual migration of these contaminants into the Mississippi River. To address this concern, the Navy developed a pilot study that involved localized injection of vegetable oil into the ground water within the Anoka County Park in an attempt to enhance the effectiveness of the OU 1 remedy. This study is currently ongoing. If the results of the pilot study are successful, the Navy will seek to implement this effort on a full-scale basis. In addition, the effectiveness of the ground water capture system will continually be evaluated and upgraded as necessary.

The ROD for OU2 and OU3, specifying Land Use Controls, was signed in September, 2003. The evaluation of protectiveness of the OU2 and OU3 remedy will be included in the next five year review.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name (from WasteLAN): Naval Industrial Reserve Ordnance Plant, Fridley		
EPA ID (from WasteLAN): MN3170022914		
Region: 5	State: MN	City/County: Fridley/Anoka
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify) _____		
Remediation status (choose all that apply): <input type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Operating <input type="checkbox"/> Complete		
Multiple OUs?* <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Construction completion date: 9 / 23 / 03	
Has site been put into reuse? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
REVIEW STATUS		
Lead agency: <input type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input checked="" type="checkbox"/> Other Federal Agency DOD/Navy		
Author name: NAVFACENGCOM, Southern Division, Charleston		
Author title:	Author affiliation: Lead Agency	
Review period:** 07 / 03 / 03 to 09 / 29 / 03		
Date(s) of site inspection: ____ / ____ / NA		
Type of review: <div style="display: flex; justify-content: space-between;"> <div> <input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> Regional Discretion </div> <div> <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> NPL-State/Tribe-lead </div> </div>		
Review number: <input type="checkbox"/> 1. (first) <input checked="" type="checkbox"/> 2 (second) <input type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify) _____		
Triggering action: <div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> Actual RA Onsite Construction at OU # ____ <input type="checkbox"/> Construction Completion <input type="checkbox"/> Other (specify) _____ </div> <div> <input type="checkbox"/> Actual RA Start at OU # ____ <input checked="" type="checkbox"/> Previous Five-Year Review Report </div> </div>		
Triggering action date (from WasteLAN): 10 / 27 / 03		
Due Date (five years after triggering action date): 10 / 27 / 03		

*["OU" refers to operable unit.]

**[Review period should correspond to the actual start and end states of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

See Section 8.0 of the document for discussion about:

- Repeated occurrences of electrical device failure
- Routinely treating groundwater extraction wells to address biological iron fouling
- Recent capture analysis
- Vegetable oil pilot study

Recommendations and Follow-up Actions:

See Section 9.0 of the document for discussion about:

- Continuing extraction of contaminated groundwater
- Vegetable oil pilot study
- USGS Groundwater capture evaluation
- Other

Protectiveness Statement(s):

Overall the remedial action for Operable Unit 1 continues to be protective of human health and the environment by preventing further migration of contaminated water off the NIROP facility and continuing to restore ground water quality in the unconsolidated aquifer at the site. Contaminated ground water remains downgradient of the NIROP facility in Anoka County Park and it is not naturally dissipating as envisioned in the ROD. As discussed in Section 9.0, a Vegetable Oil Pilot Study is currently underway to determine whether or not a full-scale vegetable oil injection remedy can be implemented to enhance the remedy regarding the contaminated ground water in the park.

Other Comments:

1.0 INTRODUCTION

The United States Navy, Southern Division, NAVFACENGCOM, has conducted a Five-Year Review of the remedial actions implemented at OU1 at the NIROP Fridley site in Fridley, Minnesota. This report documents the results of the review.

This Five Year Review determines whether the remedy for OU 1 at NIROP Fridley is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five Year Review Reports. In addition, Five Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Navy (Lead Agency) is preparing this Five Year Review report pursuant to CERCLA Sec.121 and the National Contingency Plan (NCP). CERCLA Sec.121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate as such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The Environmental Protection Agency (EPA) interpreted this requirement further in the NCP; 40 CFR Sec. 300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

This Five Year Review is the second five year review for OU 1 at NIROP Fridley. The triggering action for this review is the date of signature of the previous five year review. This Five Year Review is due to the hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure.

This Five Year Review was prepared consistent with EPA's Comprehensive Five Year Review Guidance (EPA-540-R-01-007), June 2001.

The OU2/OU3 Record of Decision was signed in September, 2003. OU2 and OU3 are soil operable units. OU2 generally corresponds to soil outside the main plant building, and OU3 generally corresponds to soil underneath the main plant building. The selected remedy for both OU2 and OU3 is Land Use Controls. There are no other OUs identified beyond OU1, OU2, and OU3. The first review for OU2 and OU3 will be conducted during the next Five Year Review.

The Federal Facility Agreement (FFA) among the United States Environmental Protection Agency (U.S. EPA), the Minnesota Pollution Control Agency, (MPCA) and the United States Department of the Navy requires that an Annual Monitoring Report (AMR) must be submitted by the Navy to the U.S. EPA and the MPCA each year following commencement of groundwater remedial action at the Naval Industrial Reserve Ordnance Plant (NIROP Fridley). The AMR includes summaries and copies of operating, maintenance, and monitoring data for the groundwater extraction system and treatment system collected from the previous calendar year. In addition, the Remedial Action Work Plan (RAWP) requires an annual evaluation of the performance of the extraction well system in achieving hydraulic containment of contaminated groundwater. The evaluation of the groundwater extraction and treatment system for 2002 is included in this report.

A summary of the estimated amount of TCE and total VOCs removed from the extracted groundwater since the start of operations is provided in each year's AMR. The 2003 AMR reported that cumulative total amount of TCE and total VOCs removed by the system was 29,137 pounds and 30,665 pounds, respectively, based on a cumulative pumping volume of 6.258 million gallons.

Using TCE concentrations measured at the beginning of 2003, approximately 754 pounds of TCE were removed in 2002, which equates to a daily removal rate of approximately 2.1 pounds. This estimate is probably biased low because the latest and lowest concentration is used to estimate the average yearly extracted TCE concentration. Using mass numbers in the AMR provided by the O&M contractor, the estimated amount of TCE removed in 2002 was 1,377 pounds and the daily removal rate was approximately 3.8 pounds. The actual TCE removal rate falls within this range.

TCE continues to be the most widespread contaminant in site groundwater (found in 77 of 85 wells sampled in March 2003) and is also present at the highest overall concentrations (TCE was found at the highest concentration in 65 of the 78 wells with positive VOC detections, ranging up to 4,700 µg/L in

March 2003). Cis-1,2-DCE was the contaminant detected at the highest concentration in 9 of 78 wells with positive VOC detections. PCE was the primary VOC in 4 of 78 wells.

Of the 78 monitoring wells and 7 extraction wells sampled in March 2003, 30 wells had TCE concentration decreases in comparison to 2001, 26 wells had TCE increases, 6 wells were unchanged, and 23 wells had not been sampled in 2001. The highest contaminant concentrations were found in shallow and intermediate-depth groundwater within the stratified drift aquifer.

Criteria exceedances were noted in compliance wells for TCE (13 detections above criteria), PCE (3 detections above criteria), and cis 1,2-DCE (one detection above criteria).

2.0 SITE CHRONOLOGY

The National Superfund Database (CERCLIS) identification number for this facility is MN317002291400. NIROP Fridley was proposed for inclusion on the National Priorities List on July 14, 1989 and was listed on November 21, 1989. The appropriate Federal Register Notice appeared on November 21, 1989.

The following chronology covers actions taken with respect to all OUs at the site.

Date	Event
1940 - 1941	Naval ordnance manufacturing facility was constructed.
1947	U.S. Navy purchased what is now the Federally owned portion of NIROP.
1942 - 1964	Northern Ordnance, Inc., a subsidiary of Northern Pump Company, operated the naval ordnance manufacturing complex.
1964	FMC Corporation purchased the southern portion of the manufacturing facility property from Northern Pump Company.
Early 1970s	Limited disposal at NIROP of paint sludge and chlorinated solvents in pits and trenches was performed.
1980	
September	U.S. Navy implemented the NACIP program to identify and control environmental contamination from past use and disposal practices.
1981	
March	Anonymous phone call to the MPCA regarding disposal practices at the FMC-operated facility.
March 16 - April 23	Three production wells at the site were sampled by the MPCA. Analysis results showed 0.035 to 0.200 milligrams per liter (mg/L) of TCE detected (RMT, July 1988).
April 24	Wells FMC-1 and NIROP -2 and -3 were discontinued for drinking water usage. Well FMC-1 was intermittently used for process cooling water until June 1983.
December 31	TCE was detected at 0.0012 mg/L at the Minneapolis water supply intake. Earlier in 1981, TCE was detected at unquantifiable levels during four sample rounds.
	Storm sewer outfalls were sampled for several constituents. Quantifiable levels of volatiles were detected in the sanitary sewer and at National Pollutant Discharge Elimination System (NPDES) outfall 20200.
	The site was divided into the North Study area (government-owned property) and South Study Area (FMC-owned property) for additional investigations by Hickok and Associates (Hickok, 1981).
1982	
March 31	Investigation of the North Study area began.

Date	Event
1983	
May	U.S. Navy authorized the Installation Restoration (IR) Program.
June	Initial Assessment Study (IAS) for the NIROP site was completed by Envirodyne Engineers (June 1983).
	As a result of the IAS, the U.S. Army Corps of Engineers (USACE) was assigned to manage site remediation. The Corps installed 33 monitoring wells on and around the site over the next 3 years.
1983 - 1984	
November 18, 1983 – March 1984	Approximately 1,200 cubic yards of soil considered hazardous and 43 drums were excavated from the North 40 area and disposed of at an off-site Resource Conservation and Recovery Act (RCRA)-permitted facility. Samples were analyzed from the soils at the base of each excavation. Trenches 3, 6, and 7 showed greater than 1 mg/L total volatiles.
May 22, 1984	The MPCA issued a Request for Response Action at the site to the U.S. Navy and FMC Corporation.
1983 - 1986	Eight rounds of groundwater sampling were completed. The last round was conducted in November 1986 by RMT, Inc. (RMT).
1986	
June	RMT, Inc. was retained by the USACE to complete the Remedial Investigation/Feasibility Study for OU1 (groundwater).
	FMC established an agreement with the MPCA to pump contaminated groundwater until total volatile levels in certain wells were less than 0.270 mg/L. Pumped water was discharged to the Pig's Eye Wastewater Treatment Plant.
1987	
March	All use of trichloroethene at NIROP was discontinued. 1,1,1-Trichloroethane was put into use in place of trichloroethene.
June	Remedial Investigation Report (RMT, June 1987) issued for OU1.
September	During excavation of an on-site utility trench, a strong odor was detected in the trench by construction workers. Soil exposed during the excavation was later monitored by MPCA using an HNu photoionization detector (PID). The trench is along the northern property line of NIROP.
	An anonymous phone call to FMC directed the MPCA's attention to a potential hazardous waste site in the vicinity of the Dealers Manufacturing facility, located approximately 1,000 feet to the east of NIROP.
November	Results of soil pore gas survey included in the A-E Quality Control Summary Report for the Soil Gas Survey (RMT, February 1988).
1988	
July	Feasibility Study Report (RMT, July 1988) issued for OU1.
1989	
February 8	The U.S. Navy established the Technical Review Committee (TRC) for the project and convened the first meeting. TRC meetings were held every three months until the beginning of the RAB.
May 22	Public meeting to present the RI/FS is held in Fridley, Minnesota.
July 14	NIROP listed as a proposed site on the NPL by the USEPA.

Date	Event
July 31	Public Repository is established at Anoka County Branch Library, 410 N. E. Mississippi St., Fridley, MN.
November 21	NIROP listed as a final site on NPL by USEPA.
1990	
May1	Navy issues final Proposed Plan for groundwater remediation after review by the MPCA and the USEPA.
May 9	Public meeting to present the Proposed Plan is held in Fridley, Minnesota.
May 1 - May 30	Public comment period for the proposed groundwater remedial action is held.
September	A Record of Decision (ROD) was signed for OU1 by the Navy, the MPCA, and the USEPA. A groundwater pump and treat alternative was the alternative selected in the ROD.
October - November	Fifty-five soil borings were advanced to assess the extent of soil contamination in four specific areas (background area, North 40 area, Hazardous Waste Storage Area C, and the southeast area near Well 9-S). The North 40 area included 22 soil borings to investigate potential soil contamination due to past disposal practices, the locations of former Hazardous Waste Storage Area C included 28 soil borings to investigate potential soil contamination associated with the storage area, and the Southeast Area included four soil borings to attempt to delineate the source(s) of volatiles reported in groundwater monitoring wells in the area. The results reported the highest concentrations of volatiles, up to 62,000 micrograms per kilogram (µg/kg), from near the decontamination pad (RMT, February 1991).
1991	
March	Federal Facility Agreement (USEPA, March 1991) issued for NIROP Fridley.
August	An initial aerial photographic review was conducted by RMT staff that included photographs spanning the period from 1945 to 1977.
	The installation of four groundwater recovery and containment wells, as well as additional groundwater monitoring wells, was completed in late 1991 for OU1.
December	A second review of the aerial photographs, including additional photographs, was performed jointly by representatives of the Navy, the USEPA, the MPCA, FMC, and RMT. As a result of the review and subsequent discussions, additional areas of investigation were included as part of the OU2 Remedial Investigation.
May	Community Relations Plan issued.
1992	
January	A Remedial Action Work Plan (RMT, January 1992) was issued for OU2. The RI of the soils operable unit addresses soil contamination in the unsaturated zone (i.e., above the water table) in areas of NIROP Fridley that are not covered by buildings or other surface structures. The scope of the soil RI was intended to investigate potential outdoor sources that may contribute to groundwater contamination.

Date	Event
August 20	Emergency Removal Operation (Bay West, August 1992) report was issued that discussed the investigation of the area referred to as the North 40 area. A total of 31 drums were excavated, sampled, and overpacked, and the drums, along with approximately 900 cubic yards of soil and debris, were removed from the excavation. Excavated drums were disposed of via incineration at USEPA Superfund RCRA-licensed facility. Associated debris (screened material) was disposed of at a sanitary landfill or a RCRA-secure landfill according to analytical results.
September	The groundwater recovery system was completed and monitoring for OU1 was started.
December	A 90-Day Determination Document (RMT, December 1992) was prepared that evaluated the effectiveness of the OU1 recovery system's operation over the first few months.
1993	
September	A Remedial Investigation Report (RMT, September 1993) was issued for OU2. Results indicated that volatile, semivolatile, pesticide, hydrocarbon, and metal contamination was present in the soils at several locations.
1994	
September	Results of East Plating Shop soil sampling were issued to the Southern Division of the Naval Facilities Engineering Command (NAVFACENGCOM) in a letter report (Bay West, September 1994). Two soil borings were completed, and several metals and cyanide were identified at concentrations greater than background levels determined during the OU2 RI.
1995	
March	A Work Plan (Halliburton NUS, March 1995) was issued for the East Plating Shop. Proposed field activities for the soil and groundwater investigation included the installation of six soil borings and three temporary monitoring wells.
April 16	First NIROP Fridley Restoration Advisory Board meeting was held.
April 1, 1995 – May 4, 1995	MK added extraction wells AT-5A and AT-5B to the GTWF to improve hydraulic containment of the GWTF.
May	Results of East Plating Shop soil and groundwater investigation were issued (Halliburton NUS, May 1995). The report identified soil and groundwater contamination under the East Plating Shop. TCE was the primary contaminant found. Other volatile organic compounds, including 1,1,1-trichloroethane (TCA), acetone, styrene, and metals such as chromium, lead, and cyanide, were detected at concentrations greater than background levels determined during the OU2 RI.
June	Thirty former areas of concern, located within the NIROP facility, were identified on a Solid Waste Management Unit (SWMU) map (UDLP, June 1995).
September	Results of a site evaluation conducted at the NIROP facility in August 1995 were presented in the Site Evaluation Report (Brown & Root Environmental, September 1995). Fifty-nine areas of concern, the sanitary sewer system, and the storm sewer system were identified as potential areas requiring further investigation.

Date	Event
1996	
February	Revisions to the Final Site Evaluation Report (Brown & Root Environmental, September 1995) identified nine additional potential areas of concern (AOCs 60-68) which were identified but not previously reported because they were not suspected sources of TCE contamination.
April - June	MK conducted a North 40 drum removal action. 23 drums and 12 smaller containers were removed as well as 100 cy of soil.
1997	
June	The Final Field Sampling Plan for OU3 RI/FS (Brown & Root Environmental) was issued.
June 25, 1997 - March 25, 1998	Phases I and II of the field investigation for OU3 as part of the RI/FS activities were completed.
February	Updated and issued Community Relations Plan.
July	The Work Plan for Operable Unit 3 Remedial Investigation/Feasibility Study (Brown & Root Environmental) was issued.
September - January 1998	Phase 1 of MK contract to construct GWTF (outside portion of work).
1998	
March 30, 1998- November 14, 1998	Phase II of MK contract to construct GWTF (inside portion of work).
August	The OU3 RI Report, Rev. 0 (Tetra Tech NUS) was issued.
September	First Five Year Review Report issued.
November	Community Relations Plan updated and issued.
1999	
August	The OU3 RI Report, final Rev. 1 (TINUS), was issued.
September	Community Relations Plan was updated and issued.
2000	
February	OU-3 FS issued - Partnering Team subsequently requests Focused FS instead.
March	1999 AMR issued; Rev 6 Remedial Action Work Plan (RAWP) issued.
April	Anoka County Park (ACP) Groundwater Investigation Report issued.
May	Basewide Work Plan (CH2MHILL Constructors, Inc.) was issued.
June	Focused FS issued - Partnering Team subsequently shelves the FS because EPA says we can go directly to a Proposed Plan for this site.
August	Final Work Plan Addendum 1 (CH2MHILL Constructors, Inc.) - Modification to the Extraction System and Abandonment of Production Wells was issued.
December	CH2MHILL Constructors, Inc. completed installation of extraction wells (AT-7, AT-8, AT-9, and AT-10); abandoned AT-2; and abandoned production wells Nos. 2 and 3.
2001	
March	2000 AMR issued; Minor Modification to OU1 Remedy Fact Sheet issued.
April	Technical Memo issued - Tech Memo finalizes the 1999 AMR and ACP Investigation Report.

Date	Event
May	Final Work Plan (Parsons Engineering Science, Inc.) - Field Application to Enhance In-situ Bioremediation of Chlorinated Solvents Via Vegetable Oil Injection was issued.
May	CH2MHILL Constructors, Inc. completed abandonment of extraction wells AT-1A and AT-4; installed packer at extraction well AT-3A; and upgraded software/hardware for the GWTF system. Start-up of the GWTF system with new extraction wells is scheduled for mid June.
September	Vegetable Oil Pilot Study Workplan finalized.
December	Anoka County Park Vegetable Oil Pilot Study – oil injected.
2002	
March	2001 AMR Issued
April	Remedial Investigation for Operable Unit 3 and Supplemental Remedial Investigation Information Report (OU2) were finalized.
June	Action Memorandum for Excavation of PAH Contaminated Soil in Area A4 of the North 40 was finalized. The excavation was completed this month.
August 2002	The Proposed Plan for Operable Unit 2 and Operable Unit 3 was finalized. The Public Comment Meeting for the Proposed Plan was held on August 22.
2003	
March	The Revised OU1 Remedial Action Work Plan was finalized.
September	The Record of Decision for Operable Unit 2 and Operable Unit 3 was finalized and signed.
September	Draft workplan for installation of new wells to confirm groundwater capture was provided, to support ongoing capture analysis.

3.0 BACKGROUND

The NIROP Fridley is located in the northern portion of the Minneapolis/St. Paul Metropolitan Area within an industrial/commercial area of the city limits of Fridley, Minnesota (see Figures 3-1 and 3-2). The site is not adjacent to any residential areas. The site is not located in an environmentally sensitive area, and is not near any known environmentally sensitive areas.

Advanced naval weapons systems are designed and manufactured at the NIROP. The northern portion of the facility is government-owned and operated by a private contractor (UDLP - Armament Systems Division), and the remainder of the facility is owned and operated independently by UDLP. The site owner and occupants are likely to change in the future. The government-owned portion of the facility constitutes what is referred to as the NIROP Fridley site.

The site comprises approximately 82.6 acres, most of which is covered with buildings or pavement. The site is situated on a broad, flat glacial drift terrace that is approximately 30 feet above and 2000 feet east of the Mississippi River.

Adjacent land use is commercial and light industrial to the north, industrial to the south, recreational to the west, and commercial/light industrial (including railroads) to the east. The projected land use is the same.

Natural resource use in the area consists of recreational activities in the Anoka County Riverfront Regional Park (Anoka County Park) that is directly across East River Road from the NIROP site and adjacent to the Mississippi River. Use of these resources does not result in access to the NIROP Fridley site, which is highly restricted by the Department of Defense. No federal or state freshwater wetlands are located within 1 mile of the site. No critical habitats of endangered species or national wildlife refuges have been identified near the site.

The NIROP Fridley site is underlain by an unconsolidated sand and gravel aquifer that overlies a bedrock aquifer. The water table is 20 to 25 feet below the ground surface in the unconsolidated aquifer, which has a saturated thickness of approximately 100 feet. A discontinuous clayey glacial till layer is present at various depths below the ground surface. The underlying bedrock consists of Prairie du Chien Dolomite and Jordan Sandstone, which are referred to as the PCJ aquifer. The basal unit of the St. Peter Sandstone that overlies the PCJ aquifer across the northern portion of the site acts as a confining layer where it is present. Where it is absent, the unconsolidated aquifer is hydraulically connected to the PCJ aquifer. Groundwater flow in the unconsolidated aquifer is generally from the northeast to the southwest.

across the site toward the Mississippi River. The groundwater containment and extraction system has altered the groundwater flow characteristics.

The City of Minneapolis Water Treatment Plant intake, which draws water from the Mississippi River, is located less than 1 mile downstream from the NIROP site. Approximately 500,000 people are served by this treatment plant.

Groundwater in portions of the unconsolidated aquifer beneath the NIROP Fridley contains Volatile Organic Compounds (VOCs). The VOCs detected in 2001 are listed as follows (from greatest frequency detected to least detected): TCE, cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), tetrachloroethene (PCE), 1,1-dichloroethane (1,1-DCA), vinyl chloride, 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), and 1,2-dichloroethane (1,2-DCA). The concentrations vary widely across the site; however, TCE has been detected more frequently and at higher concentrations than any other VOC. TCE is therefore assumed to be the primary indicator parameter for monitoring contamination and the remedial system at NIROP Fridley. Results of laboratory analyses of samples collected from groundwater monitoring and extraction wells during each calendar year are presented and discussed in the Annual Monitoring Report (AMR) that is issued each year.

During the early 1970s, paint sludges and chlorinated solvents generated from ordnance manufacturing processes were disposed of in pits and trenches in the North 40. Contaminant sources in the North 40 and beneath the NIROP building went undiscovered until December 1980, when the Minnesota Pollution Control Agency received information concerning past waste disposal practices at NIROP. Results from groundwater sampling in March and April 1981 indicated that TCE was present at 200 µg/L in NIROP water supply wells 2 and 3, and in December 1981, TCE was detected in Mississippi River water at the City of Minneapolis water treatment plant intake at 1.2 µg/L. The intake is located less than half a mile downstream from NIROP. The Safe Water Act Maximum Contaminant Level (MCL) for TCE is 5.0 µg/L. In April 1981, the NIROP water supply wells were shut down and a municipal water supply was connected.

In May 1983, an Initial Assessment Study identified that drummed wastes were disposed of in the northern portion of the NIROP (north 40). Groundwater monitoring wells were installed and sampled. From November 1983 through March 1984, approximately 1200 cubic yards of contaminated soil and 43 drums were excavated and disposed. A Remedial Investigation / Feasibility Study (RI/FS) was conducted from June 1986 until May 1989. The NIROP site was listed on the National Priorities List (NPL) in November 1989. Following the RI/FS, a proposed plan to hydraulically contain TCE contaminated groundwater was presented to the public. Initial Phase I treatment of extracted groundwater was to be

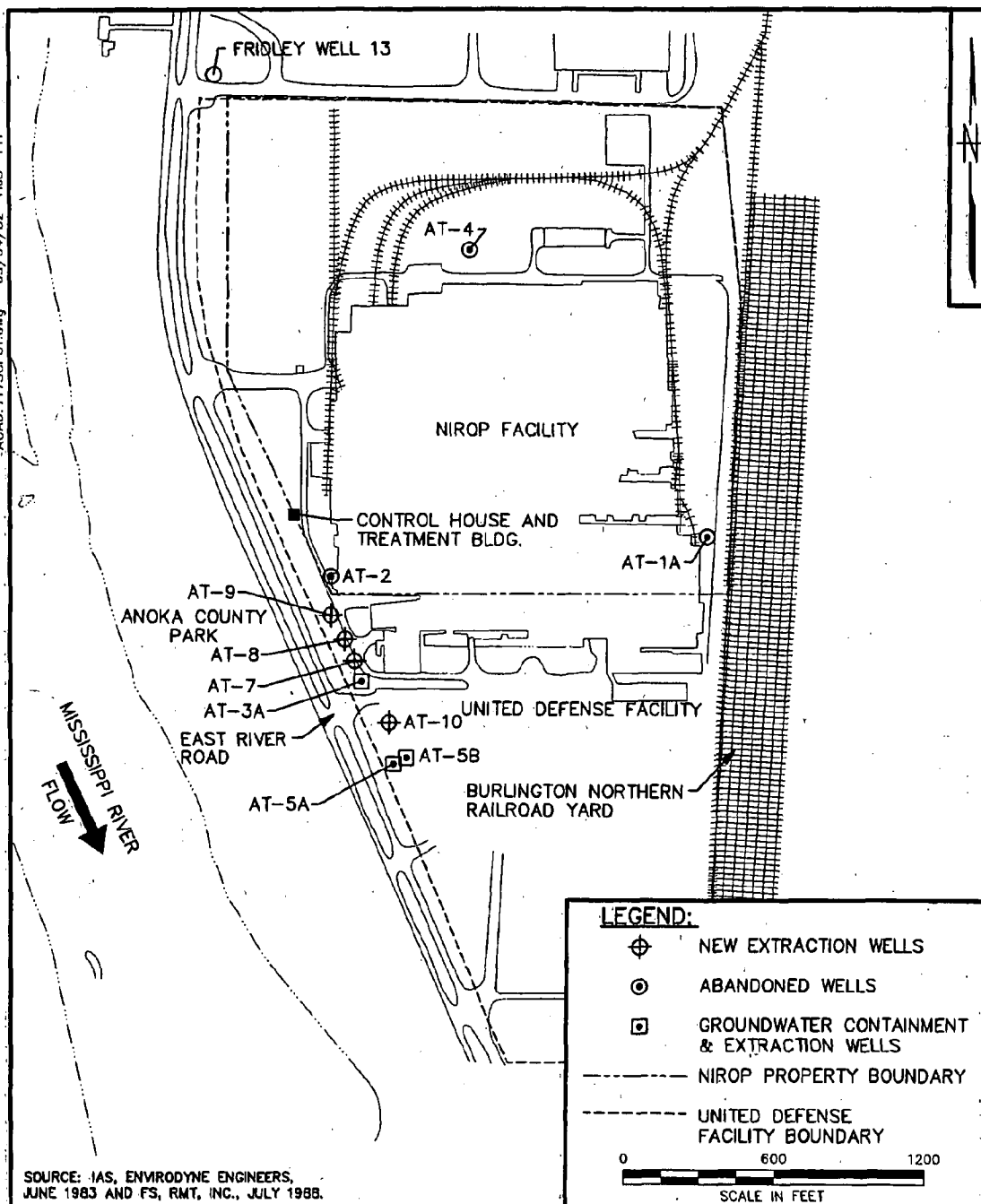
conducted at a local Publicly Owned Treatment Works (POTW). Phase II treatment involved onsite treatment with discharge of treated water in accordance with a NPDES discharge permit to the Mississippi River. The Record of Decision for Operable Unit 1 addressing groundwater contamination through hydraulic containment and treatment was signed in September 1990.

The first Five Year Review was drafted by EPA but signed by the Navy as lead agency in October, 1998. The first Five Year Review determined that remedial action for Operable Unit 1 continued to be protective of human health and the environment as it related to the remedy selected in the ROD. The residual groundwater contamination in Anoka County Park would be further evaluated by the implementation of recommendations in the Five Year Review report. These recommendations are recounted in Section 5 of this Five Year Review.

A risk assessment for OU2 was conducted in 1996. Following a revision of that risk assessment it was determined that in one subarea of OU2 risk was inordinately influenced by one single data point. Therefore, during the summer of 2002, the Navy conducted a time-critical removal action to remove approximately 35 cubic yards of soil around this location with elevated concentrations. This removal was completed in June 2002, and addressed the last known location where there were unacceptable risks in surface soil. A ROD was signed in September 2003 for OU2 and OU3 requiring land use restrictions and ensuring the concrete pit floor located in the former Plating Shop is not removed without prior regulatory approval to prevent unacceptable exposures in the future.



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SOURCE: IAS, ENVIRODYNE ENGINEERS,
JUNE 1983 AND FS, RMT, INC., JULY 1988.

DRAWN BY	DATE
HJB	9/4/02
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE	
AS NOTED	



SITE PLAN
NAVAL INDUSTRIAL
RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA

CONTRACT NO. 7173	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 3-2	REV. 0

4.0 REMEDIAL ACTIONS

Three operable units (OUs) have been identified at NIROP Fridley. Groundwater is identified as Operable Unit 1. The land outside of the main NIROP manufacturing building but within the legal boundaries of the facility, from ground surface down to groundwater elevation, has been identified as OU2. The land underneath the main NIROP building, and soils at elevations below groundwater elevation (the saturated zone) either under the building or outside the building, but within the legal boundaries of the facility has been designated as OU3. The ROD for OU1 was signed in September 1990, and the first Five Year Review for OU1 was signed in September 1998. The ROD for OU2 and OU3 is combined into a single document, and was signed in September 2003. Additional chronology details are provided in Section 2 of this Five Year Review.

The remedial action specified in the 1990 OU1 ROD called for the hydraulic containment and recovery of all future migration of contaminated groundwater from the NIROP and the recovery, to the extent feasible, of contamination downgradient of the NIROP. The selected remedy included the installation and operation of groundwater containment and extraction wells with a two-phased plan for disposal of groundwater from the well system. Contaminated ground water remains downgradient of the NIROP facility in Anoka County Park. Natural dissipation of this ground water contamination is not occurring as envisioned in the ROD. A Vegetable Oil Pilot Study is currently underway to determine whether or not a full-scale vegetable oil injection remedy can remediate the contaminated ground water in the park.

Under Phase I, groundwater from the extraction system was discharged to an existing sanitary sewer system for treatment at a local wastewater treatment facility. Under Phase II, a groundwater treatment system was constructed and is being operated to provide longer-term groundwater treatment. Treated groundwater from the on-site treatment facility is discharged to the Mississippi River through a National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permitted outfall (Outfall 020).

The groundwater extraction system and pretreatment facilities began operating in September 1992. Monitoring of these facilities and associated monitoring wells has been performed since startup according to the procedures described in the 1995 Remedial Action Work Plan (RAWP) for Groundwater Remediation as approved by the EPA and the Minnesota Pollution Control Agency (MPCA). The RAWP document has been subsequently revised, most recently in March 2003.

As required by the ROD, an evaluation of the effectiveness of the groundwater extraction system in achieving hydraulic containment of contaminated groundwater from the site during the initial 90-day operating period was submitted to the EPA and the MPCA in December 1992 (RMT, 1992). The evaluation concluded that additional groundwater extraction well(s) would be needed to achieve effective hydraulic containment. A work plan for upgrading the original extraction system was prepared and approved by the EPA and the MPCA. Two additional extraction wells were installed and placed into operation in June 1995. At that time, the combined groundwater extraction system consisted of six wells.

The concentrations of trichloroethene (TCE) and other volatile organic compounds (VOCs) in the combined discharge from the extraction wells have decreased significantly since startup in 1992. The concentrations have decreased to levels where pretreatment of groundwater was no longer needed to comply with the Metropolitan Council Environmental Services (MCES) discharge limits. With the approval of the MCES, the pretreatment system was shut down in March 1995, and the combined discharge from the extraction wells was transferred directly to the sanitary sewer.

Construction of the Phase II on-site groundwater treatment facility began in September 1997 and was completed and the facility began operation in December 1998. The discharge to the MCES sanitary sewer system has been stopped, and treated groundwater from this facility is now discharged to the Mississippi River through Outfall 020 (NPDES/SDS Permit MN0000710).

The OU1 groundwater containment and extraction system currently consists of seven pumping wells and related piping and appurtenances. A site plan showing the approximate locations of the extraction wells and associated facilities is shown in Figure 4-1. The ROD does not specifically call out remedial action objectives. However, the ROD states that the objective of the selected alternative is to address the principle threat posed by the site by providing hydraulic containment to prevent further migration of contaminated ground water off the NIROP and by recovering, to the extent feasible, contaminated ground water beneath the Anoka County Park. The ROD further states the initial goal of the selected alternative is to contain the contaminated ground water from both the NIROP and, to the extent feasible, the Anoka County Park, and that the ultimate goal is to restore ground water quality in the unconsolidated aquifer at the site to Maximum Contaminant Levels (MCLs).

The current extraction wells are identified as well numbers AT-3A, AT-5A, AT-5B, AT-7 AT-8, AT-9, and AT-10. The wells are located and constructed to contain and extract contaminated groundwater along the southwestern portion (downgradient) of the NIROP site.

A schematic diagram showing the components of the groundwater extraction and treatment facilities is shown on Figure 4-1. The discharge from each of the seven extraction wells is routed via separate forcemains to a Control House located near the security fence on the western side of the plant. Instrumentation provided at the Control House includes a flow rate indicator and a flow volume totalizer for each extraction well discharge. The combined discharge from the seven extraction wells flows via a single pipe to a Treatment Building located near the Control House. Sampling ports are located on the piping for each extraction well and on the combined discharge to the Treatment Building.

The major components of the current treatment system include a feed tank, air stripping units, and an effluent system. The feed system consists of an equalization tank to collect the groundwater pumped from the extraction well system and feed pumps to convey the groundwater from the equalization tank to the air strippers. Four low profile, tray-type air strippers are operated in parallel. The effluent water flows by gravity to the effluent sump, and the exhaust air is vented to the atmosphere. Effluent pumps convey the treated water from the effluent sump to an existing 72-inch diameter storm sewer that discharges to the Mississippi River through NPDES/SDS Outfall 020.

There are no air emission controls for the air strippers. In 2001, the anticipated changes to the air emission rates (AERs) for the groundwater treatment facility were assessed. The Navy determined that the emission rates from the GWTF operation remain within the site-specific AERs. Regulatory requirements have been met. Site-specific AERs are emission rate limits that ensure that maximum off-site ambient air impacts are below regulatory-defined allowable off-site concentrations (i.e., increased cancer risk to the public of $1E-05$). Site-specific AERs were calculated for carcinogenic compounds that could potentially be emitted from operation of the groundwater treatment facility. The approach involved using the EPA-approved Industrial Source Complex Short-Term, Version 3 (ISCST3) (Revision 2) atmospheric dispersion model to "back model" from the maximum allowable off-site impact to annual average site-specific AERs. The site-specific AERs and the maximum groundwater production rate were then used to calculate maximum allowable concentrations for groundwater entering the treatment facility. In this manner, groundwater concentrations were used to predict air emissions so that measurement of air emissions was not required. The conservatively estimated allowable groundwater contaminant concentrations were all well above measured groundwater concentrations. Therefore, no emission control measures were required for operating the groundwater treatment facility. Samples of the air stripper influent and effluent were collected during start-up of the groundwater treatment facility to confirm that site-specific AERs were met. Additional samples of influent and effluent are collected to meet NPDES permit requirements. AERs have not been exceeded in the 5-year period addressed by this Five Year Review.

It is possible that the extraction well system will be further modified in the future. Any system modifications are subject to permit approval and can result in permit modifications. These permit modifications could result in modified AERs.

Table 4-1 identifies the Operable Unit 1 ground water Chemicals of Concern (COCs); their respective ARARs as Maximum Contaminant Levels (MCLs) pursuant to the federal Safe Drinking Water Act (SDWA); and the range of concentrations of each COCs found during the last appropriate sampling event. Also this table identifies the state Health Risk Limits for these COCs. The ROD does also specify that MCLs are remediation objectives.

Table 4-2 identifies the current Operable Unit 1 ground water treatment system COCs; their respective ARARs as daily maximum concentration limits identified in the National Pollutant Discharge Elimination System (NPDES)/State Disposal system (SDS) Permit MN0000710, dated November 20, 1997; and the range of concentrations of each COC found during the last NPDES/SDS permit sampling event.

Table 4-3 identifies the current COCs for Operable Unit 1 that are surface water COCs and are entering the Mississippi River from contaminated ground water in the park. The table identifies the respective TBCs (which are the same as the surface water treatment system COCs and their respective ARARs; however the TBCs for TCE include the following: the drinking water + fish consumption criterion of 25 µg/L; the acute maximum aquatic life standard of 2,500 µg/L; and the final acute aquatic life criterion of 5,000 µg/L - see Attachment I to the Five-Year Review, dated October 27, 1998); and the range of concentrations of each COC found during the last appropriate sampling event in the compliance monitoring wells used for monitoring the discharge of contaminated ground water to the river.

As stated by the ROD, "[t]he remedy will comply with the ARARs by meeting the MCL for TCE as the target cleanup level for the site. The alternative [OU1 remedy] will reduce the toxicity, mobility, and volume of TCE in the aquifer. By meeting the MCL for TCE, other VOCs will also be reduced proportionately."

The objectives of groundwater monitoring, as detailed in the March 2003 RAWP, are as follows:

- Evaluate the ability of the groundwater extraction system to effectively contain downgradient migration of contaminants and provide water quality improvement.
- Assess the potential for contamination from on-site sources and upgradient (off-site) sources.
- Evaluate air stripper emissions to the atmosphere.

- Evaluate whether the remedies comply with the ROD.
- Evaluate whether the remedies are protective of human health and the environment.
- Evaluate the progress of the remedies in achieving the goals specified in the ROD.
- Evaluate whether project permits are met.
- Evaluate the relative contaminant concentrations along the flow path in relation to the following: upgradient groundwater conditions, known and potential source areas, capture and non-capture of the groundwater contaminant plume, residual contamination beyond the effectiveness of the capture of the remedial system and discharge to the river, and vertical head relationships and the potential flow of contaminants from one aquifer interval to another.

The objectives for the monitoring system have been further refined based upon the data quality objectives (DQOs) decision-making process that was executed by the NIROP Partnering Team. Meetings held in March 19-23, 2001, July 17-19, 2001, and March 6-7, 2002 were used to better define the objectives and formal decision-making process for the site. As determined in these meetings "DQO Problem C: Groundwater Monitoring for Overall Contamination at NIROP" defined six problem statements/decision rules which should be addressed, at least in part, by groundwater monitoring at this site. These problem statements/decision rules are generally defined below:

- Decision Rule 1: Determination of capture system performance.
- Decision Rule 2: Determination of contaminant concentrations at Mississippi River compliance wells.
- Decision Rule 3: Determination of change in the plume shape, size, and location.
- Decision Rule 4: Determination of contaminant concentrations relative to surface water and groundwater standards
- Decision Rule 5: Determination of capture system performance, evaluation of system modifications, evaluation of alternative approaches, evaluation of technical impracticability, and/or alternative concentration limit (ACL).

- Decision Rule 6: Determination of practicability of the remedy and evaluate an ACL.

Air stripper emissions to the atmosphere are evaluated using site-specific AERs established to ensure that maximum off-site ambient air impacts are below regulatory-defined allowable off-site concentrations. Table 4-4 presents the allowable air concentrations, AERs, and allowable groundwater concentrations. The allowable groundwater concentration is the level that will not cause the allowable air concentration to be exceeded, based on modeling.

A trained operator oversees operation of the water treatment process. A site O&M manual already exists, but it is currently being updated and converted to electronic media for ease of access and future updates.

The Navy develops and maintains monthly Treatment System Reports detailing the WWTP O&M. These reports include a narrative overview, recap of scheduled maintenance, summary of problems and solutions, and operating statistics. Operating statistics including monthly and cumulative treated water volumes, electrical meter readings, and on-stream factor, are provided in tabular form and in graphical form. The status is detailed and conveyed to EPA and MPCA at each Partnering Team meeting and Restoration Advisory Board (RAB) community meeting. Meeting intervals vary, but the Partnering Team meets on average every two months and the RAB meets at least twice per year.

Current annual Operation and Maintenance (O&M) costs for the treatment plant operation are approximately \$275,000.

It is not meaningful to compare current O&M costs to anticipated costs developed prior to the 1990 remedy selection for the following reasons:

- The original design anticipated use of granular activated carbon (GAC) to treat the air coming off the strippers. To date, based on groundwater contamination, resulting air emissions from the strippers have not warranted use of the GAC. Costs have not been incurred for use and periodic replacement of GAC.
- Two new pumping wells, AT-5A and AT-5B, were added in 1995 to improve performance.
- The plant capacity has been increased to approximately 850 gpm from approximately 600 gpm at 1990 design.

- Biological iron fouling has resulted in meaningfully increased maintenance requirements for pumps and well screens.
- Mineral hardness fouling of pipes and appurtenances has resulted in meaningfully increased maintenance requirements for cleaning and replacement. (The system upgrade employs a food-grade polymer to prevent mineral deposits.)

Recently, the system has experienced increased failure rates for electronic components resulting in the replacement of power conditioner units, programmable logic controller components, and motor controls among other items. Evaluation of the system is continuing by the Navy and by manufacturer representatives to address these issues. There are no indications that these failures have impaired the system long-term performance or resulted in any increased risk to human health or the environment.

The ROD specifies that the Navy will control health risks in the future by implementation of a ground water treatment system or other appropriate measures should a supplemental water supply well system be installed in Anoka County Park. To date, no additional water supply systems have been installed in Anoka County Park. As no water supply wells have been installed, this component of the remedy has not been necessary.

TABLE 4-1
GROUNDWATER CHEMICALS AND TARGET CLEANUP LEVELS
NIROP FRIDLEY
FRIDLEY, MINNESOTA

Parameter	Maximum Contaminant Level (µg/L)	Health Risk Limit (µg/L)
1,1-Dichloroethane	—	70
1,1-Dichloroethene	7	6 ⁽¹⁾
1,2-Dichloroethene (cis-)	70	70
1,2-Dichloroethene (trans-)	100	100
Tetrachloroethene	5	7
1,1,1-Trichloroethane	200	600
Trichloroethene	5	30 ⁽²⁾
Vinyl chloride	2	0.2

Maximum contaminant levels (MCLs) per 40 CFR 141.

— MCL not available.

Health Risk Limit (HRL) per Minnesota Rules 4717.7100-4717.7800.

1 — A value of 80 µg/L has been proposed for 1,1-dichloroethene.

2 — While a HRL was promulgated for trichloroethene, due to research that has become available since the HRLs were promulgated, the Minnesota Department of Health no longer recommends the HRL value.

TABLE 4-2

**CURRENT GROUNDWATER TREATMENT SYSTEM COCs
RANGE OF CONCENTRATIONS
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA**

PARAMETER	PERMIT LIMITS NPDES/SDS MN0000710 November 20, 1997 (µg/L)	RANGE OF CONCENTRATIONS April - June 2003 (µg/L)
pH	6.0 - 9.0 SU	7.7 - 8.3 SU
1,1,1-Trichloroethane	200	<1.0 - <1.0
1,1-Dichloroethane	70	<1.0 - <1.0
1,1-Dichloroethylene	6	<1.0 - <1.0
1,2-Dichloroethylene (trans-)	100	<1.0 - <1.0
1,2-Dichloroethylene (cis-)	70	<1.0 - <1.0
Methylene Chloride	5	<1.0 - <1.0
Tetrachloroethylene	3.8	<1.0 - <1.0
Trichloroethylene	5	<1.0 - <1.0

TABLE 4-3

**DETECTED CONCENTRATIONS OF VOCs IN COMPLIANCE WELLS
MARCH 2003 SAMPLING EVENT⁽¹⁾
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA**

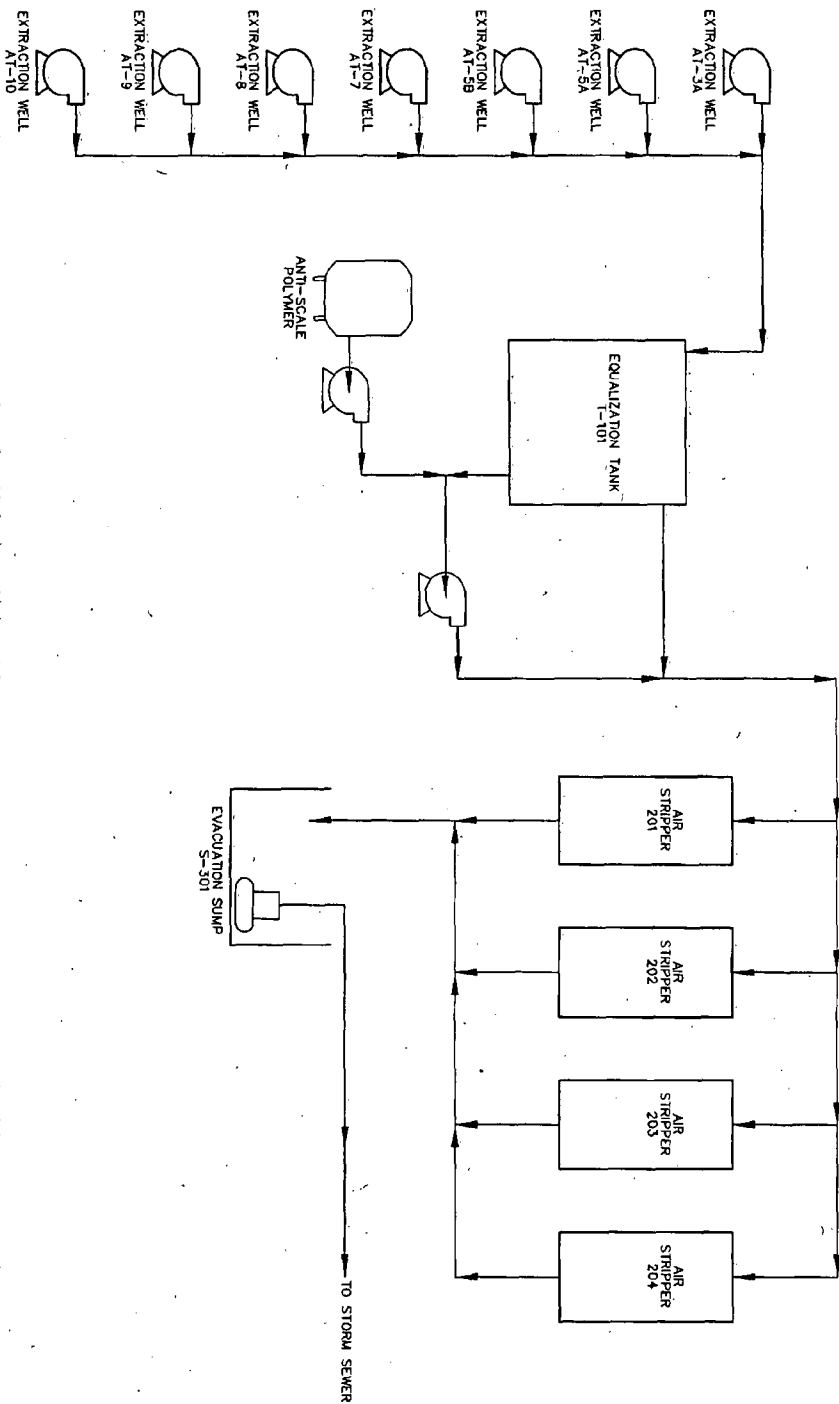
MN SW Criteria(2) (ug/L)	Volatile Organic Compounds (ug/L)				
	CIS-1,2-DCE	TRANS-1,2-DCE	PCE	TCE	Vinyl Chloride
Chronic Standard	70	100	3.8	25	0.18
Maximum Standard	n/a	n/a	428	6,988	n/a
Final Acute Value	n/a	n/a	857	13,976	n/a
Domestic Consumption	n/a	n/a	5	5	2
Well Number					
Wells in the Shallow Monitoring Zone (Shallow Unconfined Aquifer)					
27-S	NS	NS	NS	NS	NS
MS-43S	21	1.6	ND	220	ND
MS-44S	49	4.4	ND	110	ND
MS-47S	NS	NS	NS	NS	NS
MS-49S	12	0.94 J	0.44 J	46	ND
USGS-5	ND	ND	ND	ND	ND
Wells in the Intermediate Monitoring Zone (Shallow Unconfined Aquifer)					
16-IS	4.6	0.5 J	2.1	49	ND
MS-43I	4.2	ND	ND	14	ND
MS-44I	120	13	ND	750	0.44
MS-47I	45	6	0.82 J	340	ND
MS-49I	9.9	ND	4.2	76	ND
Wells in the Deep Monitoring Zone (Deep Confined Aquifer)					
16-D	3.2	0.45 J	6.2	32	ND
MS-43D	3	ND	1.1	17	ND
MS-44D	30	2.7	ND	220	ND
MS-47D	3.4	0.41 J	6	48	ND
MS-49D	1.1	ND	1.5	10	ND
Wells in the PC Bedrock Aquifer					
MS-48PC	NS	NS	NS	NS	NS


Notes:

1. Sampling took place during non-pumping conditions.
 2. Minnesota Surface Water Criteria. source: <http://www.revisor.leg.state.mn.us/arule/7050/0220.html>
Minnesota Rule 7050.0220 Specific Standards of Quality and Purity By Assoc. Use of Classes
 - Chronic Standard* - the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity.
 - Maximum Standard* - the highest concentration of a toxicant in water to which aquatic organisms can be exposed for a brief time with zero to slight mortality.
 - Final Acute Value* - an estimate of the concentration of a pollutant corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute toxicity tests conducted on a pollutant.
 - Domestic Consumption* - standard for domestic consumption of Class 1 drinking water.
- ND - non-detect.
NS - not sampled.

TABLE 4-4**SITE-SPECIFIC ALLOWABLE AIR EMISSION RATES AND GROUNDWATER CONCENTRATIONS
NIROP FRIDLEY
FRIDLEY, MINNESOTA**

Parameter	Allowable Air Concentrations (µg/m³)	Allowable Air Emission Rate (µg/sec)	Allowable Groundwater Concentration (µg/L)
1,1-Dichloroethane	500	1.35E+8	2,100,000
1,1-Dichloroethene	0.2	5.4E+4	850
Methylene chloride	20	5.4E+6	85,000
Tetrachloroethene	17.2	4.6E+6	73,000
Trichloroethene	5.9	1.6E+6	25,000



NO.	DATE	REVISIONS	BY	CHNO	APPO	REFERENCES	<div> <div>  </div> <div> GROUNDWATER EXTRACTION AND TREATMENT SYSTEM NAVAL INDUSTRIAL RESERVE ORDNAVANCE PLANT FRIEDLEY, MINNESOTA </div> </div>
						DRAWN BY DATE HJB 9/4/02 CHECKED BY DATE COST/SCALE AREA SCALE NOT TO SCALE	CONTRACT NO. 7842 APPROVED BY DATE APPROVED BY DATE DRAWING NO. 4-1 REV 1

5.0 PROGRESS SINCE THE LAST FIVE YEAR REVIEW

The protectiveness statement from the previous Five Year Review (signed by EPA on September 29, 1998) was as follows:

'We certify that the remedial action for Operable Unit 1 continues to be protective of human health and the environment as it relates to the remedy selected in the ROD. The residual groundwater contamination in Anoka County Park will be further evaluated by the implementation of the recommendations in this Five Year Review Report.'

To that end, the previous Five Year Review included the following recommendations:

'We recommend the continued operation, maintenance, and upgrade (if necessary) of the groundwater containment and recovery system, with eventual on-site treatment and discharge of treated groundwater in accordance with the NPDES permit.'

We recommend that the following determinations be made and that the response activities occur, if deemed appropriate, to enhance the performance of the remedy with respect to the residual groundwater contamination in Anoka County Park.

The following list of determinations to be made result from a NIROP Partnering meeting which was held to reach consensus and take action regarding the contaminated groundwater in Anoka County Park, not influenced by the groundwater containment and recovery system.

- By September 1999, the Navy will confirm whether the present groundwater extraction well system has achieved substantial hydraulic containment of the contaminant plume through evaluation of chemical and physical groundwater data and use of that data in a groundwater model. If the determination is made that a substantial amount of contaminated groundwater is flowing past the extraction well system, the extraction well system will be enhanced so that groundwater from the NIROP does not continue to flow into Anoka County Park.*
- The Navy will fill data gaps in the existing groundwater monitoring network and revise the Remedial Action Monitoring Plan (RAMP) to document the additional monitoring by September 1999.*

- *The Navy will determine if any potential sources of contamination exist in Anoka County Park that may impact residual groundwater contamination levels in the area where residual groundwater contamination is present by September 1999.*
- *The MPCA will conduct another surface water assessment to incorporate new groundwater sampling information and groundwater modeling information to determine whether surface water standards and criteria are exceeded after the above recommended actions are completed.*
- *The Navy will determine what can be done to promote reduction of residual groundwater contamination in Anoka County Park to a level that will significantly reduce residual groundwater contamination, and determine if a response action will enhance the effectiveness of the selected remedy as it relates to residual groundwater in Anoka County Park by September, 1999, and if warranted, will conduct a response action that will significantly reduce residual groundwater contamination and enhance the effectiveness of the selected remedy as it relates to residual groundwater contamination from NIROP in Anoka County Park by September 2000.'*

In corresponding order, the results of these commitments and obligations are as follows:

The Navy continued operation and maintenance of the groundwater treatment system. The system was upgraded to approximately 850 gpm capacity and was upgraded to complete treatment entirely on site with final discharge via NPDES permit. Start up for the upgraded facilities occurred in June 2001.

The following activities occurred to enhance performance of the remedy with respect to the residual groundwater contamination in Anoka County Park

- In 1999 the Navy, through its facilitated partnering process, determined that it was possible that a substantial amount of contaminated groundwater was flowing past the extraction well system. Different analytical methods provided different quantification of the amount of contaminated groundwater. Different viable professional interpretations of remaining uncertainties supported the need for the Navy to upgrade the extraction well cutoff line, resulting in the December 2000 completion of the installation of new extraction wells AT-7, AT-8, AT-9, and AT-10. Existing extraction wells AT-1, AT-2, and AT-4 were closed and abandoned per all applicable requirements. Therefore, there are a total of seven extraction wells operating under the current remedial system. Following the system upgrades, the United States Geological Survey (USGS) joined the partnering process at Fridley, and is currently conducting a new, separate capture evaluation. Preliminary

conclusions from the capture analysis include consensus that the evaluation did not warrant additional pumping at this time; that the annual monitoring performed at the site would be reviewed on a yearly basis and that trends in downgradient contaminant levels would be used as another evaluation tool to monitor the effectiveness of capture (as decided in the DQO process). In addition, field tests should proceed to resolve which aquifer zones several monitoring wells should be assigned to. The Navy agreed to install a nest of monitoring wells, including a shallow and intermediate well, downgradient of AT-3A to serve as "sentinel" wells to monitor the downgradient impact of AT-3A.

- The Navy, through its facilitated partnering process, ultimately developed a comprehensive RAWP which was approved by EPA and MPCA in March 2003. The RAWP resolves all known data gaps in the previous groundwater monitoring network, although these will continue to be reevaluated on an annual basis in the AMR. Between the date of the prior Five Year Review and March 2003, the Navy provided interim RAWP updates as the partnering team resolved all outstanding issues, to enable each year's AMR.
- The Navy, through its facilitated partnering process, developed a program of investigation to determine if potential sources of groundwater contamination exist in Anoka County Park. This work plan was issued in July 1999, and resulted in field activities in the final calendar quarter of 1999. A report was issued in April 2000, although some technical details remained unresolved until an April 2001 Technical Memorandum was issued. The report concluded that 'both hydraulic and chemical data suggest that elevated concentrations in the ACP are likely a remnant of contamination present before the extraction wells were in place and persist due to natural hydraulic conditions. The contamination is not a result of a source area in ACP.'
- The MPCA has previously determined that groundwater contamination, measured at the agreed line of compliance wells nearest the river, exceeds surface water quality criteria. Groundwater contaminant concentrations in the compliance wells have not significantly improved since the previous Five Year Review. However, river water samples collected at NIROP and downstream to the municipal intake since the previous Five Year Review have not indicated any measurable chlorinated VOCs.
- In order to determine what can be done to promote reduction of residual groundwater contamination in Anoka County Park, the Navy is currently conducting in-situ pilot testing of enhanced natural attenuation by vegetable oil injection into the groundwater. A preliminary report of monitoring and analysis during the year following vegetable oil injection is due during late calendar year 2003.

6.0 FIVE YEAR REVIEW PROCESS

The Restoration Advisory Board (RAB) was verbally notified at the May 14, 2003 regular meeting of the Navy's intent to develop the second Five Year Review Report. All persons on the RAB mailing list are provided with copies of the RAB meeting minutes, and were provided with a separate announcement of the Navy's development of the Five Year Review. A public notice that the second Five Year Review was being conducted was published on June 19 in the Sun Focus newspaper.

The Draft Five Year Review Report was provided to the EPA and MPCA for review and comment on July 3. The EPA and MPCA provided comments and proposed revisions by September 15. Comments from EPA and MPCA were then addressed and resolved.

The document has been available for public review throughout the process. No public comments were received. The Navy will sign the document by October 27. The Navy, EPA, and MPCA may agree to adjust some of the dates, provided final signature is attained by October 27, 2003 - 5 years following the signature of the first Five Year Review Report.

To prepare this Five Year Review, the following documents were reviewed:

- Groundwater Operable Unit ROD – September 1990
- Federal Facility Agreement (FFA) – March 1991
- Five Year Review – September 1998
- Field Investigation Report at the NIROP and Anoka County Riverfront Park – April 2000.
- Remedial Action Work Plan (RAWP) – March 2003
- April 2003 Treatment System Report – May 2003.

As discussed in the introduction, each year's AMR includes summaries and copies of operating, maintenance, and monitoring data for the groundwater extraction system and treatment system collected from the previous calendar year. This data was reviewed while preparing this Five Year Review. The TCE isoconcentration maps and the Approximate Capture Zone Configurations are attached to this Five Year Review Report. See Attachment 1.

Data reviewed included monthly summaries of treatment plant operation provided by the Navy through their on-site O&M contractor BayWest. A recent summary report is attached to this Five Year Review Report. See Attachment 2.

The Navy, EPA, and MPCA agreed on the sampling program for the next five years in the March 2003 RAWP. In addition, at the conclusion of each year's AMR, the Navy will evaluate the adequacy of the monitoring program, and proposed modification where necessary. The EPA and MPCA regularly review the AMR.

Because the operation of the treatment plant requires active operator interaction, versus a passive landfill cap remedy, a formal inspection was not required. The plant operator already examines the system performance and facilities on a daily basis. In addition, the plant operator prepares monthly summaries of treatment plant operation and facilities status.

Interviews were not conducted. Because NIROP is a fenced operating plant with controlled access, limited access to remedy components (extraction wells, treatment buildings, controls systems) within NIROP is guaranteed. There are no institutional controls identified in the Groundwater Operable Unit ROD. However, the Navy and MPCA (via communication with Minnesota Department of Health (MDH)) ensure that no drinking water wells are installed at NIROP or in Anoka County Park. Representatives of the Anoka County Park board are included on the RAB mailing list and frequently attend RAB meetings. The Anoka County Park board members have most recently been kept in increased contact as the Navy conducts its in-situ pilot testing in Anoka Park. All wells and injection points in Anoka Park must be approved by the Anoka County Park board, in addition to meeting MDH requirements.

Success or problems with system operations/O&M and unusual situations or problems at the site are detailed in the Navy's monthly Treatment System Reports. See Table 6-1 for a summary of significant system downtime during the period addressed by this Five Year Review.

TABLE 6-1

**GROUNDWATER TREATMENT SYSTEM OPERATIONAL HISTORY
SIGNIFICANT DOWNTIME EVENTS (10 OR MORE CONSECUTIVE DAYS)
SINCE OCTOBER 27, 1998
NAVAL INDUSTRIAL RESERVE ORDNANCE PLANT
FRIDLEY, MINNESOTA**

DATES OF DOWNTIME	CAUSE OF DOWNTIME	REMEDY
December 10, 1999 Phase II of Groundwater Remediation System brought online with discharge to Mississippi River	NA	NA
December 23, 1999 – January 15, 2000	Voluntary – pump test evaluations in progress	NA
May 3 – May 12, 2001	Voluntary – connect new pumping wells to system	NA
August 21 - October 1, 2001	Voluntary – study static aquifer conditions	NA
October 1 – October 12, 2001	PLC failure	Missing component in PLC replaced.
January 1 – March 19, 2003	Multiple items upon restart of voluntary idled system: electrical control issues, frozen/burst pipes, control valve malfunction, well redevelopment	Repaired pipes, replaced electrical components, replaced valve body, completed well redevelopment.
April 10 – April 22, 2003	Voluntary – acid clean air strippers	NA
May 13 – June 20 2003	Electrical/control issues	Replace power conditioner and flowmeters and level controls.

7.0 TECHNICAL ASSESSMENT

Question A: Is the remedy functioning as intended by the decision documents?

As stated in Section 9 of the ROD, "[t]he objective of this alternative [the OU1 remedy] is to address the principal threat posed by the site by providing hydraulic containment to prevent further migration of contaminated ground water off the NIROP [facility] and by recovering, to the extent feasible, contaminated ground water beneath the Anoka County Parkland...The ultimate goal is to restore ground water quality in the unconsolidated aquifer at the site to Maximum Contaminant Levels..."

The remedy is functioning to meet the objective and ultimate goal of the decision document, the ROD, as cited above. Per the ROD, the remedy was designed to provide hydraulic containment and recovery of groundwater. Since the ROD was signed, the Navy has conducted various evaluations of system efficiency. These evaluations resulted in the addition of extraction wells AT-5A, AT-5B prior to the first Five Year Review, and wells AT-7, AT-8, AT-9 and AT-10 within the past couple years. Numerous groundwater monitoring wells have also been installed to provide water level and chemical data points to aid these evaluations. The Navy continues to evaluate hydraulic containment on an annual basis in each year's Annual Monitoring Report.

A recent United States Geological Survey evaluation of the OU 1 remedy acknowledged that there was good capture in the shallow aquifer zone, but some degree of uncertainty regarding the extent of capture, particularly in the intermediate and deep aquifer zones. However, the evaluation did not conclude that additional pumping wells were warranted at this time. The evaluation acknowledged that the ground water monitoring data for the site would be reviewed on a yearly basis and that trends in down gradient contaminant levels would be used as another evaluation tool to monitor the effectiveness of capture. In the future, if contaminant levels down gradient of the OU 1 remedy do not decrease with time, capture effectiveness would be re-evaluated.

The Navy is continuing to evaluate the feasibility of remediating the contaminated ground water beneath Anoka County Park beyond the influence OU 1 remedy via the Vegetable Oil Pilot Study because it does not appear that the ground water contamination in the park is naturally dissipating as envisioned by the ROD. The outcome of this evaluation is not available at this time.

Although progress continues, it is impossible to provide a firm time estimate for restoration of groundwater quality in the unconsolidated aquifer to Maximum Contaminant Levels.

Current operating procedures are expected to maintain the system's effectiveness. Large variances in O&M costs are not expected to indicate remedy problems except that large irregular O&M costs could represent large equipment failure and subsequent replacement. The system could be offline during the period between failure and replacement. Since it was first placed into service, the system has experienced infrequent extended downtime without any long-term impact, most notably during the 2001 system capacity upgrade. The recently increasing frequency of electrical equipment breakdowns is being tracked by the Navy in consultation with equipment manufacturer's representatives. It is possible that the increasing frequency is related to a single as-yet undiagnosed electrical problem. It is not anticipated that downtime for system repairs would place protectiveness at risk.

NIROP remains a fenced, controlled-access facility, which serves to prevent exposure. There are no institutional controls. There are no other actions necessary to ensure that immediate threats have been addressed. There are no immediate threats.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

Exposure Assumptions

There were two potential human pathways related to contaminated ground water that were identified in the ROD. The first pathway started with contaminated ground water from NIROP discharging into the Mississippi River then into the Minneapolis Water Works (MWW) then to finished water from the MWW and finally to humans who consumed the finished water. Detectable levels of TCE have previously been found in the MWW intake; however, in the past five years, none has been found in the MWW intake above the COCs' respective method detection limits. The other unchanged ground water pathway cited in the ROD is direct consumption of NIROP contaminated ground water. (See page 2, second complete paragraph, Description of the Selected Remedy, Declaration, of the ROD.) Exposure assumptions involving these two potential ground water pathways are still valid.

Another potential human pathway was alluded to in the ROD, inhalation of COCs from the OU1 treatment. The federal Clean Air Act is cited as an action-specific ARAR (see Table 3 of the ROD). This inhalation pathway exposure assumption remains valid. Air Emission Rates (AERs) are designed to evaluate emissions from the OU1 remedy to ensure that humans are protected from this exposure pathway.

Finally, the ROD alluded to a surface water human pathway involving the consumption of contaminated fish and drinking water and an ecological pathway to organisms in the Mississippi River via the discharge of contaminated ground water into the river. However, these pathways were more clearly identified and discussed in Attachment 1 to the Five-Year Review, dated October 27, 1998. These potential exposure pathways remain valid.

Cleanup Levels

The cleanup levels for TCE for human consumption of water remain valid and are designed to protect all human pathways identified above. However, the cleanup levels in the ROD for the human pathway involving the consumption of contaminated fish and the ecological pathway to organisms in the Mississippi River identified in the ROD were clarified and modified in the Five-Year Review dated October 27, 1998. The updated surface water criteria and standards identified in the last five year review have not changed and remain valid. (See Attachment 1 to the Five-Year Review Report, dated October 27, 1998, and the NPDES permit.) The surface water criteria and standards for some of the surface water TBCs identified in the last five year review have been used to establish action levels for the contingency wells for the Vegetable Oil Pilot Study currently underway.

Toxicity Data

Toxicity data for TCE have not changed in the past five years.

Remedial Action Objectives

The overall remedial action objectives (RAOs) for NIROP, as identified in the answer to Question A have not changed in the past five years; however the RAOs have been refined in a series of DQOs. These DQOs can be found in the January, 2003 Remedial Action Work Plan.

There have been no changes in land use, and none are expected. No new human health or ecologic routes of exposure or receptors have been identified. There are no new contaminants or contaminant sources identified. There are no previously unanticipated toxic byproducts of the remedy to address. There have been no changes to physical site conditions or the understanding of these conditions.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No new information has come to light that could call into question the protectiveness of the remedy. There are no newly identified ecological risks. There have been no impacts from natural disasters.

Preliminary conclusions from the recent capture analysis include consensus that the evaluation did not warrant additional pumping at this time; that the annual monitoring performed at the site would be reviewed on a yearly basis and that trends in downgradient contaminant levels would be used as another evaluation tool to monitor the effectiveness of capture (as decided in the DQO process). In addition, field tests should proceed to resolve which aquifer zones several monitoring wells should be assigned to. The Navy agreed to install a nest of monitoring wells, including a shallow and intermediate well, downgradient of AT-3A to serve as "sentinel" wells to monitor the downgradient impact of AT-3A.

8.0 ISSUES

The Navy is closely monitoring the repeated occurrences of electrical device failures. If additional significant electrical device failures were to occur, resulting in extended pumping system downtime, protectiveness could be impacted.

The groundwater extraction wells must be routinely treated to address biological iron fouling. There are several treatment options available and the Navy is assessing which would provide the longest period of relief for the cost incurred. Since operational startup, biological iron fouling has been being addressed without any apparent impact to system effectiveness or remedy protectiveness.

Preliminary conclusions from the recent capture analysis include consensus that the evaluation did not warrant additional pumping at this time; that the annual monitoring performed at the site would be reviewed on a yearly basis and that trends in downgradient contaminant levels would be used as another evaluation tool to monitor the effectiveness of capture (as decided in the DQO process). In addition, field tests should proceed to resolve which aquifer zones several monitoring wells should be assigned to. The Navy agreed to install a nest of monitoring wells, including a shallow and intermediate well, downgradient of AT-3A to serve as "sentinel" wells to monitor the downgradient impact of AT-3A.

The vegetable oil pilot study is continuing, with no final conclusions or recommendations to date.

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Extraction of Contaminated Groundwater: The pump and treat system must remain in operation, as key groundwater contaminant concentrations continue to exceed Federal MCLs.

Vegetable Oil Pilot Study: The Navy will continue the Vegetable Oil Pilot Study in Anoka Park. Upon successful completion of the study, use of that technology may be expanded. The Navy, EPA, and MPCA are in agreement on the DQOs that must be satisfied to consider a successful completion to the study. In order to confirm favorable treatment trends, the Navy has already extended the study schedule. At this time, the final round of groundwater sampling for the study is scheduled for August. Several months after the sampling, the Navy will provide EPA and MPCA with a summary report with recommendations. Following the completion of the study, the Navy may recommend extending the treatment zone, or may propose that an alternative technology be considered for testing, or some other option.

USGS Groundwater Capture Evaluation: The Navy is providing EPA and MPCA with a highly-technical groundwater capture evaluation prepared by USGS. Preliminary conclusions from the capture analysis include consensus that the evaluation did not warrant additional pumping at this time; that the annual monitoring performed at the site would be reviewed on a yearly basis and that trends in downgradient contaminant levels would be used as another evaluation tool to monitor the effectiveness of capture (as decided in the DQO process). In addition, field tests should proceed to resolve which aquifer zones several monitoring wells should be assigned to. The Navy agreed to install a nest of monitoring wells, including a shallow and intermediate well, downgradient of AT-3A to serve as "sentinel" wells to monitor the downgradient impact of AT-3A. The Navy will also continue to provide a capture evaluation discussion in each year's AMR, ultimately incorporating the USGS work as appropriate.

The Navy will continue the following activities:

- Operation, routine maintenance, and repair of the OU 1 remedy to meet ROD objectives.
- Operation of and monitoring the performance of the OU 1 remedy according to the NPDES permit requirements to determine if surface water quality standards required in the plant discharge have been met.

- Calculation and reporting of site emission rates of airborne treatment system COCs to ensure that the AERs are not being exceeded.
- Sampling and reporting data from surface water compliance wells and comparison of the results to determine whether or not surface water TBCs for the Mississippi River are met prior to plume discharge to the river.
- Monitor hydraulic heads, ground water chemistry, chemical trends, and pumping rates according to reporting requirements of the annual monitoring reports.

If the Vegetable Oil Injection Pilot Study is not successful, the Navy will then reevaluate the adequacy of the pilot study and/or evaluate alternate remedies.

10.0 PROTECTIVENESS STATEMENT

Overall the remedial action for Operable Unit 1 continues to be protective of human health and the environment by preventing further migration of contaminated water off the NIROP facility and continuing to restore ground water quality in the unconsolidated aquifer at the site. Contaminated ground water remains downgradient of the NIROP facility in Anoka County Park and it is not naturally dissipating as envisioned in the ROD. As discussed in Section 9.0, a Vegetable Oil Pilot Study is currently underway to determine whether or not a full-scale vegetable oil injection remedy can be implemented to enhance the remedy regarding the contaminated ground water in the park.

The ROD for OU2 and OU3, specifying Land Use Controls, was signed in September, 2003. The evaluation of protectiveness of the OU2 and OU3 remedy will be included in the next five year review.

11.0 NEXT REVIEW

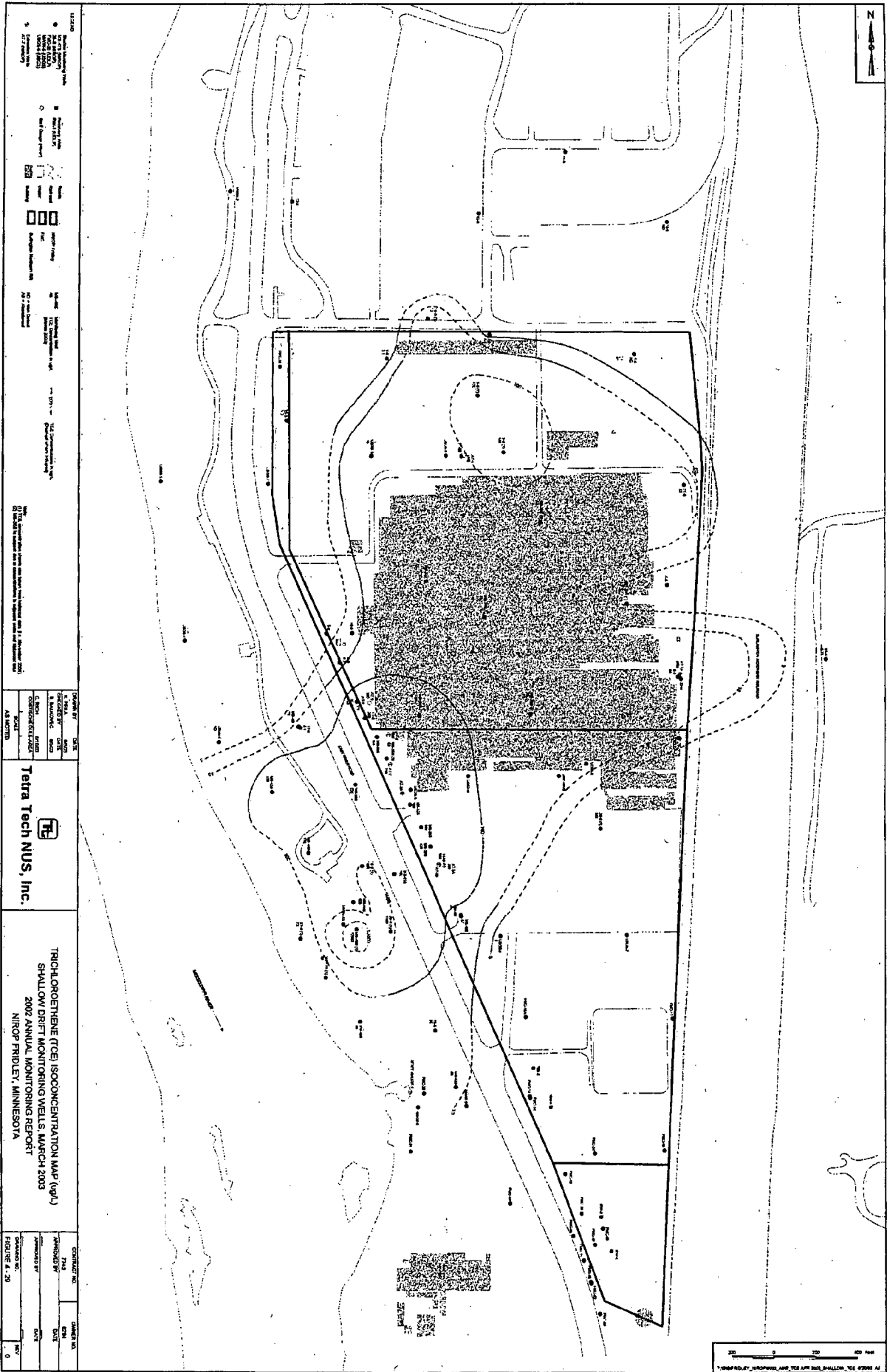
The next Five Year Review for NIROP Fridley is required by October 2008, five years from the date of this review.

ATTACHMENT 1

TCE ISOCONCENTRATION MAPS AND APPROXIMATE CAPTURE ZONE CONFIGURATIONS

ALL FIGURES FROM THE 2002 ANNUAL MONITORING REPORT

- Figure 4-29 TCE Isoconcentration Map, Shallow Drift Monitoring Wells
- Figure 4-30 TCE Isoconcentration Map, Intermediate Drift Monitoring Wells
- Figure 4-31 TCE Isoconcentration Map, Deep Drift Monitoring Wells
- Figure 5-1 Approximate Capture Zone Configurations, Shallow Drift Extraction Wells
- Figure 5-2 Approximate Capture Zone Configurations, Intermediate Drift Extraction Wells
- Figure 5-3 Approximate Capture Zone Configurations, Deep Drift Extraction Wells
- Figure 5-4 Approximate Capture Zone Configurations (All)



Legend

- Isocentration Map (TCE)
- Shallow Drift Monitoring Well
- Monitoring Well
- Monitoring Point
- Monitoring Station
- Monitoring Well
- Monitoring Point
- Monitoring Station
- Monitoring Well
- Monitoring Point
- Monitoring Station

Scale

0 100 200 300 400 500 600 700 800 900 1000

Feet

Project Information

Project Name: Trichloroethylene (TCE) Isocentration Map (TCE)

Project Number: 2002 ANNUAL MONITORING REPORT

Project Location: NIPORT FIDLEY, MINNESOTA

Client Information

Client Name: Tetra Tech NUS, Inc.

Client Address: 10000 N. 10th Ave, Suite 100, Minneapolis, MN 55412

Client Phone: (612) 555-1234

Client Email: info@tetra-tech.com

Map Information

Map Title: Trichloroethylene (TCE) Isocentration Map (TCE)

Map Date: 2002

Map Scale: 1:1000

Map Legend

Isocentration Map (TCE)

Shallow Drift Monitoring Well

Monitoring Well

Monitoring Point

Monitoring Station

Monitoring Well

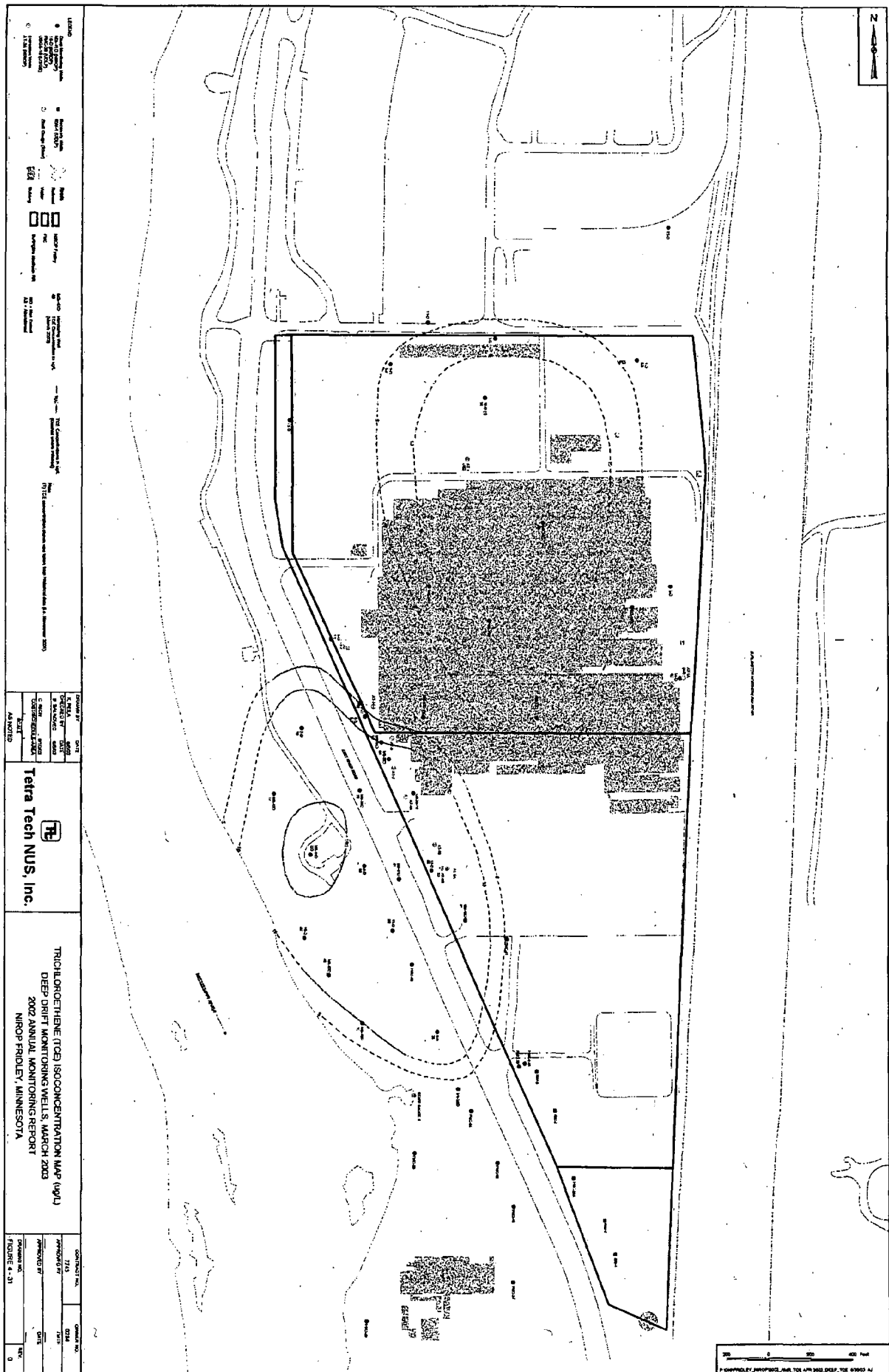
Monitoring Point

Monitoring Station

Monitoring Well

Monitoring Point

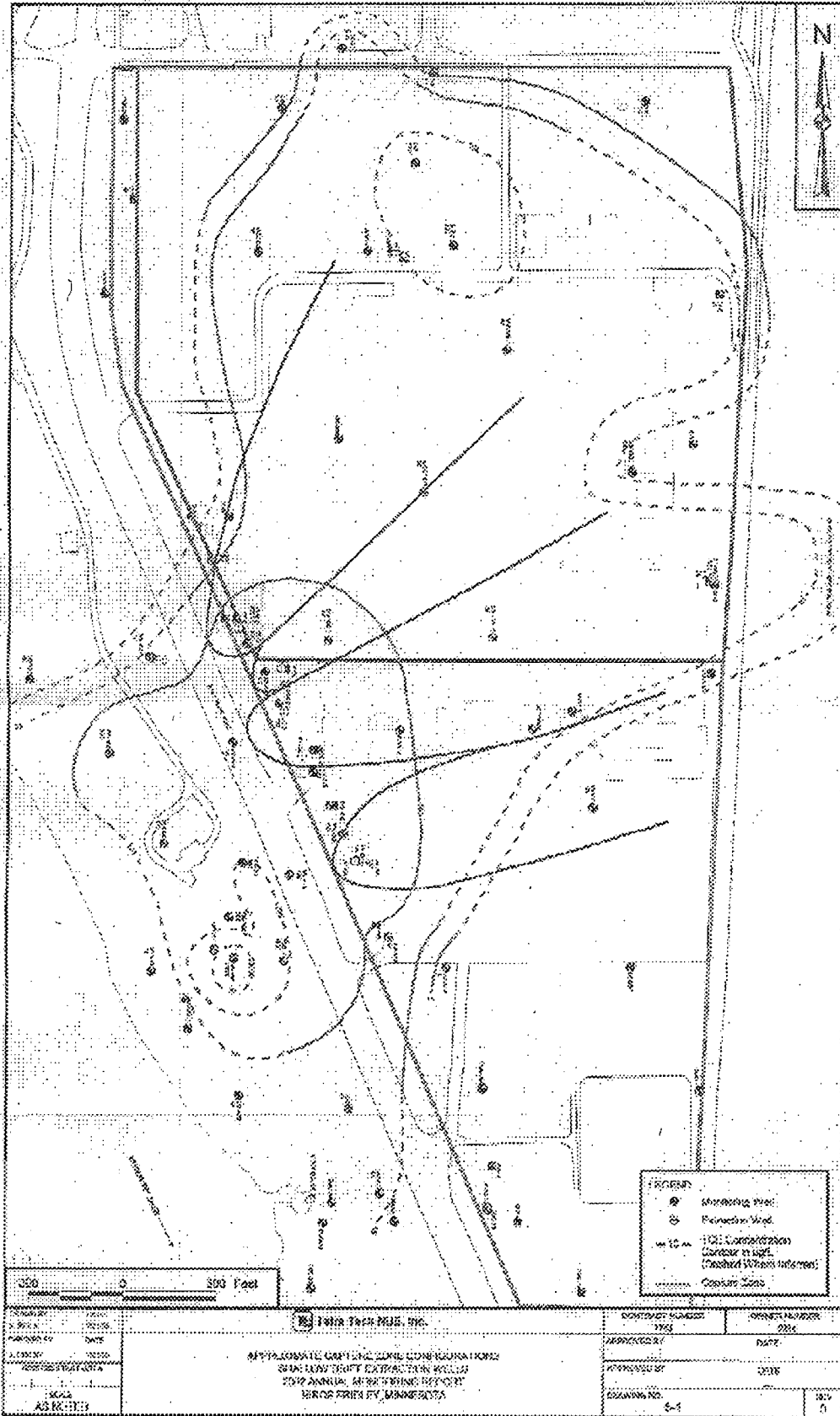
Monitoring Station



Tetra Tech NUS, Inc.

**TRICHLOROETHENE (TCE) ISOCENTRATION MAP (ug/L)
DEEP DRIFT MONITORING WELLS, MARCH 2003
2002 ANNUAL MONITORING REPORT
NIROP FIDLEY, MINNESOTA**

DATE	DATE
APPROVED BY	DATE
FIGURE 4-21	REV. 0



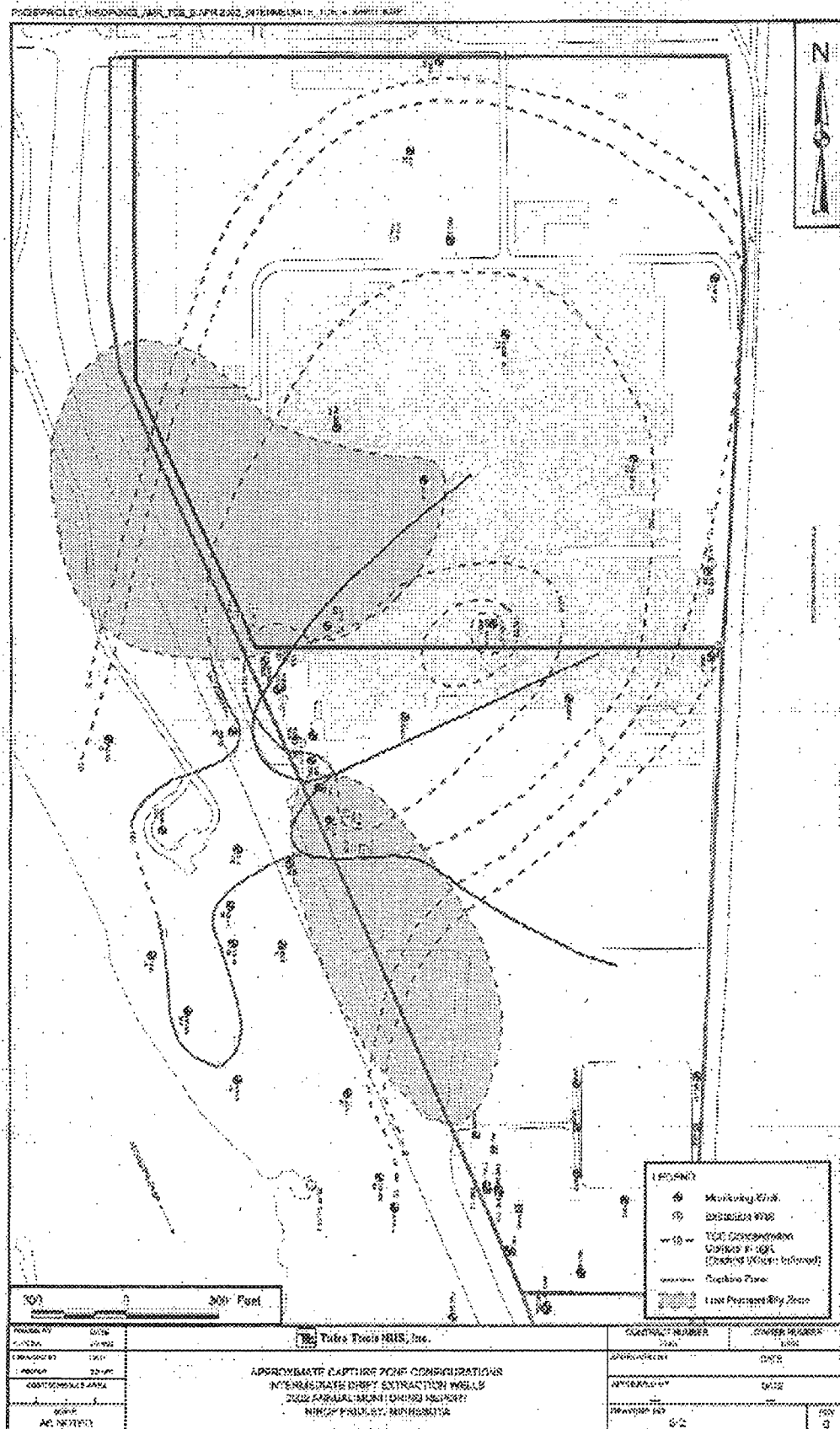
0 500 Feet

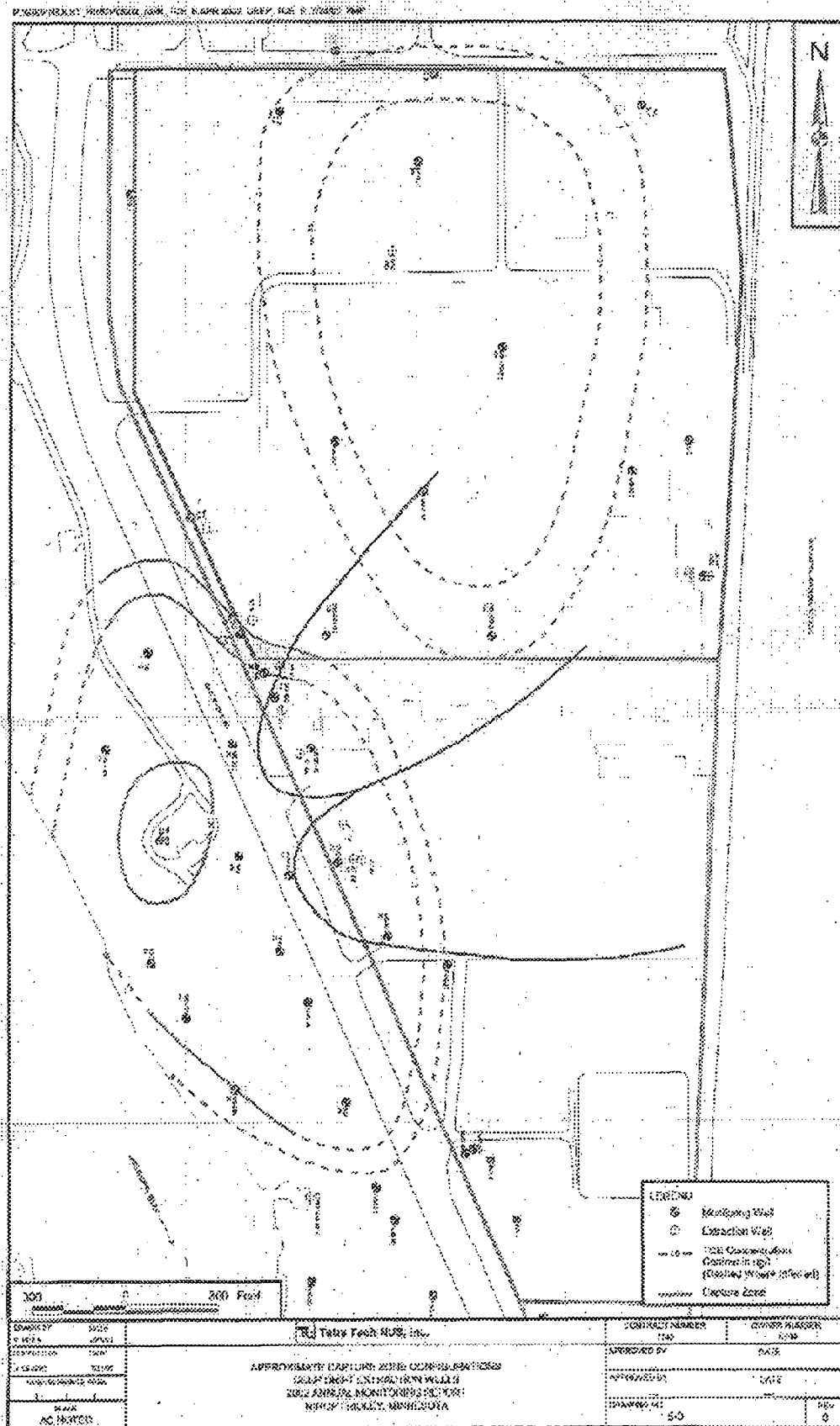
LEGEND
 ● Monitoring Well
 ⊕ Production Well
 ⊕ 101 Contamination Corridor in light (checked within 1000 feet)
 --- Contour Line

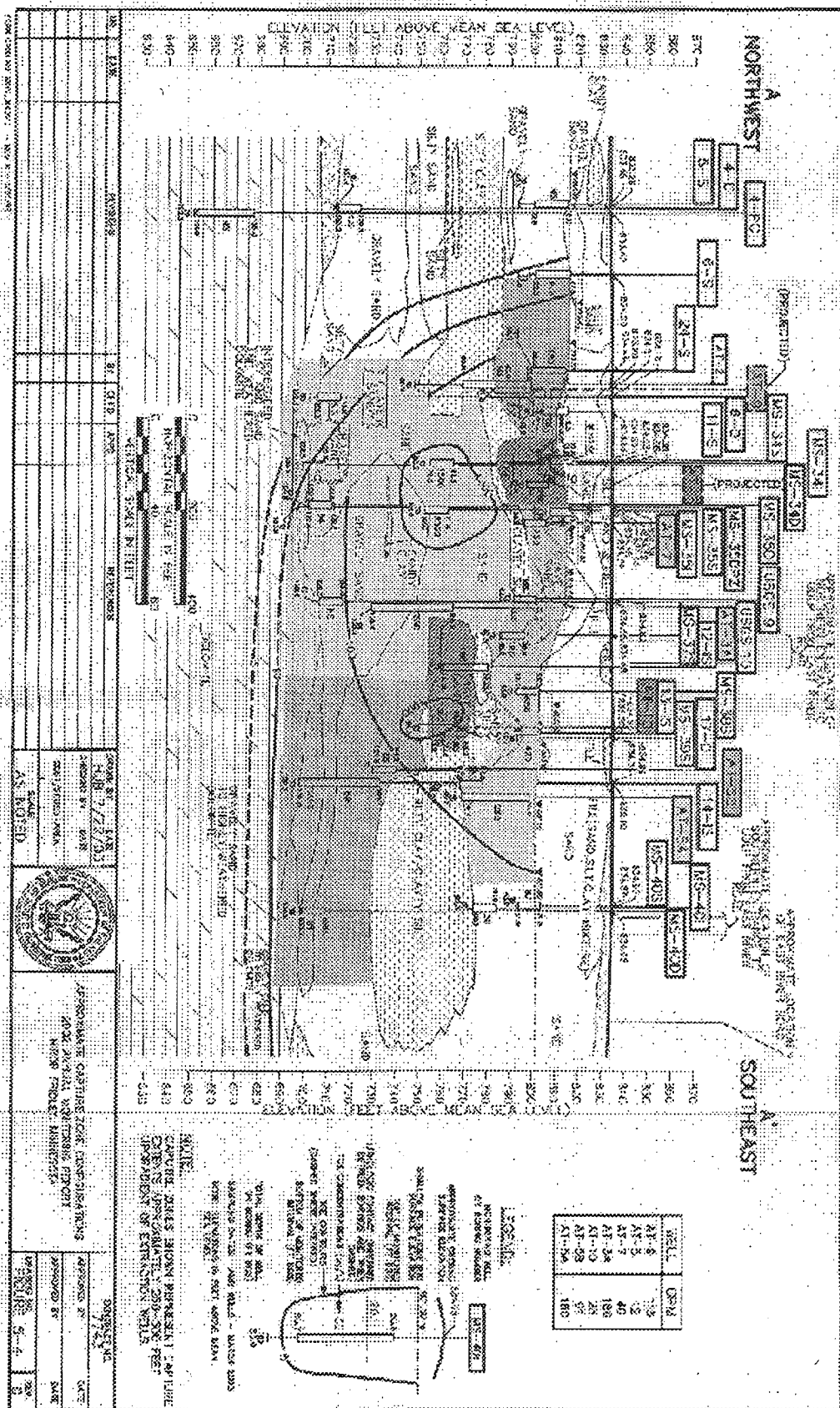
DATE: 12/10/10
 BY: [Signature]
 CHECKED BY: [Signature]
 SCALE: AS SHOWN

APPROXIMATE CAPTURE ZONE CONTOURS FOR THE LUNDA TRACT EXTRACTION WELLS
 2010 ANNUAL MONITORING REPORT
 LUNDA TRACT, MINNESOTA

CONTRACT NUMBER: 100
 PROJECT NUMBER: 200
 DATE: 12/10/10
 DRAWING NO: 2-1







ATTACHMENT 2

TREATMENT PLANT REPORT

Bay West

Delivering Environmental, Industrial,
Marine, and Emergency Solutions

Bay West, Inc. * 24 Hours: 800-279-0456 * www.baywest.com

HQ: 5 Empire Drive, St. Paul, MN 55103
651-291-0456 * FAX 551-291-0099

10620 Widmer Road, Lenexa, KS 66215
913-663-2915 * FAX 913-663-3067

119 Lafferty Blvd., Broussard, LA 70506
337-839-8223 * FAX 337-839-9817

October 15, 2003

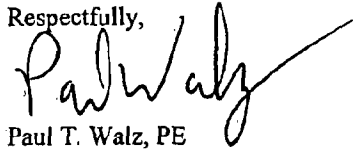
Mr. Dan Owens, ES32
US Navy SouthDiv
Naval Facilities Engineering Command
2155 Eagle Drive
PO Box 190010
North Charleston, SC 29419-9010

RE: September 2003 Treatment System Report
Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota
Contract N68 950-99-D-0205

Dear Dan:

Enclosed please find the above-referenced report for the Naval Industrial Reserve Ordnance Plant (NIROP) in Fridley, Minnesota. Bay West, Inc. (Bay West) has prepared this report in accordance with the requirements of the Contract Documents for the project. If you have any questions or comments regarding the information being submitted, please contact me.

Respectfully,



Paul T. Walz, PE
Senior Engineer
651/291-3491
paulw@baywest.com

Enclosures

cc: Lamar Sims, EFA Midwest (w/o enclosures)
David P. Seely, US EPA
Mark Sladic, Tetra Tech Nus, Inc.
Megan Kari, Bay West, Inc.

BWJ990726
Docs # 61697



Monthly Project Status Report September 2003
Facility Maintenance
Naval Industrial Reserve Ordnance Plant - Fridley, Minnesota
Prepared by Bay West, Inc.
Southern Division - District II
Contract No. N68 950-99-D-0205

OVERVIEW

On April 13, 2000, the Navy transferred responsibility for the operation and maintenance (O&M) of the ground water treatment facility (GWTF) at the Naval Industrial Reserve Ordnance Plant (NIROP) in Fridley, Minnesota, from Morrison Knudsen (MK) to Bay West, Inc. (Bay West). Prior to the transfer, MK trained Bay West personnel for a period of 30 days on system operation. This training included daily operation of the system, layout of the O&M manual, common alarms, and routine maintenance.

SYSTEM OVERVIEW

- The GWTF was in operation for 719 hours during the month of September 2003.
- The on-stream factor for September was 99.86%. The on-stream factor is the actual operation time divided by the available operation time.
- The system processed 27,560,000 gallons of ground water in September for a total of 1,277,652,000 gallons to date. Approximately 4,532,000 gallons of ground water were sent to the sanitary sewer this month.
- Effluent sampling from Outfall 020 was performed on September 2 and 17, 2003. As described in the "Problems and Solutions" section of this report, laboratory analytical results for trichloroethylene (TCE) from the September 2 sampling event were above National Pollutant Discharge Elimination System (NPDES) permit limits. Laboratory analytical results from September 17, 2003 were below NPDES permit limits for all analytes.
- Electrical use was approximately 52,166 kWh for September.
- Approximately 6,564 pounds of TCE have been removed since system start-up.

SCHEDULED MAINTENANCE

- Checked bearing temperatures on influent pumps.
- Visually inspected the flow meters and level probes for material buildup and proper operation.
- Examined the safety showers/eyewash stations to assure adequate performance.
- Continuing the pressure gauge inventory to document current operational status of all gauges.
- On September 22, 2003, Industrial Electric installed new heaters in the motor control box for P-301A, since they would not reset after tripping. Bay West then tested the new heaters, which operated properly.

PROBLEMS AND SOLUTIONS

- TCE analytical results from outfall sampling performed on September 2, 2003 (i.e., 17 µg/L), exceeded NPDES permit criteria (i.e., 5 µg/L). Bay West reviewed the operational data from previous sampling events to evaluate possible trends and determine possible causes for the exceedence. Bay West graphed the air and water flow rates for the four air strippers over time and determined that ASU-202 had lower air flowrates than the other air strippers after approximately August 26, 2003. These graphs are included as Appendix 1.

Bay West inspected ASU-202 and noticed an air damper valve handle and stem was loose and leaking air. Bay West attempted to re-secure the valve handle, but the handle and stem pulled out of the pipe. It was not possible to determine whether the valve was actually open, so the air stripper was



shut down, blower piping disconnected, and the valve inspected. Based upon this work, Bay West determined the valve was not completely open. Bay West opened the valve, reassembled the piping and re-secured the valve handle and stem. Bay West then restarted the blower and observed the air flow rate increase by approximately 500 cfm. ASU-202 was returned to normal operation. Bay West believes the valve may have become loose while it was actuated during the initiation of air stripper acid cleaning work which began on August 26, 2003. The air flow rate graphs described above show a reduction in the ASU-202 air flow rate on this date.

Bay West re-sampled the outfall on September 17, 2003 and requested a rush turnaround time to determine if damper repair resolved the discharge exceedence. Due to concerns associated with the potential for further non-compliance, Bay West switched the effluent piping to discharge treated water to the sanitary sewer on September 17, 2003, pending confirmation from the laboratory that analytical results were once again in compliance with permit limits.

On September 22, 2003, Bay West received results from the outfall sampling completed on September 17, 2003. The results indicated the TCE concentration was $<1.0 \mu\text{g/L}$, which is in compliance with the NPDES permit. Bay West switched the effluent discharge from the sanitary sewer back to the storm sewer. A total of 4,532,000 gallons of treated water were sent to the sanitary sewer from September 17-22, 2003.

- On September 18, 2003, Bay West received an alarm from the autodialer that the system had shutdown. Bay West mobilized to the site and discovered that B-203 had turned off, which shut the rest of the system down. Bay West checked the electrical for B-203 and discovered that it had tripped. Bay West reset the electrical switch for B-203 and restarted the system. Bay West observed the system and allowed it to stabilize. The system was shutdown for a total of one hour.
- As detailed in the August Status Report, the flowrate for AT-7 steadily decreased and by September 9, 2003, AT-7 had faulted out upon arrival. Bay West attempted to restart the pump, but it would only run for 2-3 minutes before faulting out again. Bay West had a technician from E.H. Renner and Sons, Inc. (Renner) mobilize to the site on September 11, 2003 to troubleshoot the pump. After testing the pump, the technician pulled the pump from the well and discovered the pitless adapter, drop pipe, and pump were full of iron bacteria sludge. The technician removed the drop pipe and pump, brought them back to their facility, cleaned and tested the components, and determined they still achieved the design flow. Renner re-installed the pump and drop pipe on September 22, 2003. After the re-installation, Renner purged the line from AT-7 to Building 52/53 using compressed air, which forced a significant amount of iron bacteria sludge through the line. The compressed air was allowed to purge the line until the water was visibly cleaner, which took approximately 20 minutes. AT-7 was restarted and has operated near the design flowrate of 50 gpm since September 22, 2003.
- On September 25, 2003, Bay West activated the low airflow alarms on each of the air strippers. These alarms were deactivated by the original O&M contractor (MK) over 3.5 years ago, as they were generating numerous false alarms that resulted in system shut down. Bay West will monitor the treatment system to determine whether false alarms return.

TABLES

1. Ground Water Treatment Facility (GWTF) Operations
2. Electrical Meter Readings

FIGURES

1. Monthly GWTF On Stream Factor
2. GWTF Total Treated Flow
3. Total Discharge
4. Gallons Treated vs. Time



Tables

NIROP FRIDLEY
Ground Water Treatment Facility (GWTF)

Month	OPERATIONS (hrs)			WATER DISCHARGED (thousands of gallons)					WATER TREATED (thousands of gallons)	
	Available	Operating	On-stream factor	to Storm	to Sanitary	Untreated to Sanitary	Total to Sanitary	% Storm	Monthly	Cumulative
Nov-98	480	480	100%	0	17,524	0	17,524	0%	17,524	17,524
Dec-98	718	628	87%	16,078	7,087	0	7,087	69%	23,165	40,689
Jan-99	744	743	100%	25,571	0	0	0	100%	25,571	66,260
Feb-99	672	672	100%	23,938	0	0	0	100%	23,938	90,198
Mar-99	744	744	100%	27,394	0	0	0	100%	27,394	117,592
Apr-99	720	720	100%	25,254	0	0	0	100%	25,254	142,846
May-99	744	744	100%	23,291	0	0	0	100%	23,291	166,137
Jun-99	720	713	99%	25,823	0	0	0	100%	25,823	191,960
Jul-99	744	744	100%	22,266	0	0	0	100%	22,266	214,226
Aug-99	684	684	100%	21,634	0	0	0	100%	21,634	235,860
Sep-99	720	720	100%	18,205	0	0	0	100%	18,205	254,065
Oct-99	744	744	100%	23,029	0	0	0	100%	23,029	277,094
Nov-99	720	720	100%	22,783	0	0	0	100%	22,783	299,877
Dec-99	535	535	100%	12,818	0	0	0	100%	12,818	312,695
Jan-00	356	356	100%	10,400	0	0	0	100%	10,400	323,095
Feb-00	695	694	100%	16,944	0	0	0	100%	16,944	340,039
Mar-00	744	744	100%	27,131	0	0	0	100%	27,131	367,170
Apr-00	720	720	100%	25,899	0	0	0	100%	25,899	393,069
May-00	744	744	100%	27,458	0	0	0	100%	27,458	420,527
Jun-00	719	719	100%	25,136	0	0	0	100%	25,136	445,663
Jul-00	744	744	100%	25,637	0	0	0	100%	25,637	471,300
Aug-00	744	744	100%	24,341	0	0	0	100%	24,341	495,641
Sep-00	655.5	655.5	100%	22,559	0	0	0	100%	22,559	518,200
Oct-00	744	744	100%	25,955	0	0	0	100%	25,955	544,155
Nov-00	720	718	99.7%	25,759	0	0	0	100%	25,759	569,914
Dec-00	744	744	100%	27,404	0	0	0	100%	27,404	597,318
Jan-01	744	744	100.0%	24,666	0	0	0	100%	24,666	621,984
Feb-01	672	671	100%	23,956	0	0	0	100%	23,956	645,940
Mar-01	744	737	99.1%	24,694	0	0	0	100%	24,694	670,634
Apr-01	720	720	100%	24,964	0	0	0	100%	24,964	695,598
May-01	604.25	602.25	99.7%	13,656	0	0	0	100%	13,656	709,254
Jun-01	710	708	100%	20,000	0	0	0	100%	20,000	729,254
Jul-01	730	730	100.0%	18,077	0	0	0	100%	18,077	747,331
Aug-01	491	491	100%	17,921	0	0	0	100%	17,921	765,252
Sep-01	0	0	100.0%	0	0	0	0	100%	0	765,252
Oct-01	736	473	64%	21,376	0	0	0	100%	21,376	786,628
Nov-01	720	720	100.0%	30,205	0	0	0	100%	30,205	816,833
Dec-01	744	744	100%	28,114	0	0	0	100%	28,114	844,947
Jan-02	742	737	99.3%	30,483	0	0	0	100%	30,483	875,430
Feb-02	672	672	100%	25,538	0	0	0	100%	25,538	900,968
Mar-02	744	744	100.0%	29,957	0	0	0	100%	29,957	930,925
Apr-02	744	744	100%	28,569	0	0	0	100%	28,569	959,494
May-02	744	741	99.60%	28,656	0	0	0	100%	28,656	988,150
Jun-02	720	720	100%	22,131	0	0	0	100%	22,131	1,010,281
Jul-02	744	744	100.00%	21,367	0	0	0	100%	21,367	1,031,648
Aug-02	744	744	100%	28,328	0	0	0	100%	28,328	1,059,976
Sep-02	630.25	630.25	100.00%	20,861	0	0	0	100%	20,861	1,080,837
Oct-02	744	744	100%	21,417	0	0	0	100%	21,417	1,102,254
Nov-02	720	720	100.00%	25,003	0	0	0	100%	25,003	1,127,257
Dec-02	744	742	100%	25,327	0	0	0	100%	25,327	1,152,584
Jan-03	744	55	7.39%	1,048	0	0	0	100%	1,048	1,153,632
Feb-03	672	0	0%	0	0	0	0	100%	0	1,153,632
Mar-03	744	309	41.53%	13,387	0	0	0	100%	13,387	1,167,019
Apr-03	527	426	81%	16,584	0	0	0	100%	16,584	1,183,603
May-03	744	298.5	40.12%	7,448	0	0	0	100%	7,448	1,191,051
Jun-03	720	253	35%	10,775	0	0	0	100%	10,775	1,201,826
Jul-03	734	576.25	78.51%	22,629	0	0	0	100%	22,629	1,224,455
Aug-03	733	640	87%	25,591	46	0	46	100%	25,637	1,250,092
Sep-03	720	719	99.86%	23,028	4,532	0	4,532	83.6%	27,560	1,277,652

Note: Available hours are 24 hours per day, less scheduled down time and power outages.

NIROP FRIDLEY
Ground Water Treatment Facility (GWTF)

Date	Electrical Meter Readings (kWh)				
	MCC #1	MCC #2	Wells 2, 3A, 5A, 5B	Well 1A	Well 4
2/1/2000	57,305	620,300			
3/1/2000	59,597	656,054			
3/9/2000	60,348	667,580	18,260	3,284	2,312
4/3/2000	63,080	704,113	38,698	6,043	4,879
5/1/2000	66,067	746,920	60,940	9,238	7,715
6/1/2000	68,972	793,455	86,495	12,728	10,775
7/1/2000	71,562	840,441	110,243	16,307	
7/6/2000					13,701
8/1/2000	73,881	881,304	130,691	19,559	16,686
9/1/2000	76,316	924,799	152,695	22,976	17,671
10/2/2000	78,561	964,802	172,714	26,079	20,178
11/1/2000	80,952	7,402	195,655	29,408	22,454
12/4/2000	83,561	56,966	225,897	33,105	26,269
1/2/2001	85,851	101,872	254,750	36,270	28,761
2/1/2001	88,106	143,918	282,532	37,122	28,761
3/1/2001	90,240	190,303	314,000	41,079	28,761
4/3/2001	92,677	230,575	335,297	43,736	28,761
5/1/2001	94,779	269,617	357,244	46,212	28,761
6/5/2001	97,821	304,746	*	*	*
7/2/2001	102,175	338,500	*	*	*
8/2/2001	106,592	378,885	*	*	*
9/12/2001	111,321	411,960	*	*	*
10/18/2001	112,956	423,988	*	*	*
11/1/2001	117,010	449,405	*	*	*
12/4/2001	126,457	508,500	*	*	*
1/2/2002	134,884	561,005	*	*	*
2/1/2002	142,948	609,742	*	*	*
3/1/2002	150,583	657,407	*	*	*
4/1/2002	159,332	712,889	*	*	*
5/1/2002	167,808	763,704	*	*	*
6/3/2002	176,272	818,688	*	*	*
7/1/2002	182,246	856,688	*	*	*
8/1/2002	188,404	896,139	*	*	*
9/3/2002	196,255	948,362	*	*	*
10/1/2002	202,142	986,542	*	*	*
11/1/2002	209,581	1,039,261	*	*	*
12/2/2002	216,632	1,092,748	*	*	*
1/1/2003	223,233	0	*	*	*
2/1/2003	224,233	1,146,792	*	*	*
3/19/2003	227,523	1,151,329	*	*	*
4/3/2003	230,589	1,171,154	*	*	*
5/1/2003	235,275	1,198,526	*	*	*
6/4/2003	237,675	1,214,499	*	*	*
7/1/2003	240,411	1,232,123	*	*	*
8/1/2003	246,351	1,269,113	*	*	*
9/2/2003	253,306	1,312,067	*	*	*
10/1/2003	260,662	1,356,877	*	*	*

* Electrical metering for the extraction wells runs through MCC #1

- The electrical meter in the main treatment area was misread on 1/1/03, thus it was not reset. December electricity usage was estimated to be the same as November 2002.

O&M Start Date: 11 November 1998

Table 2

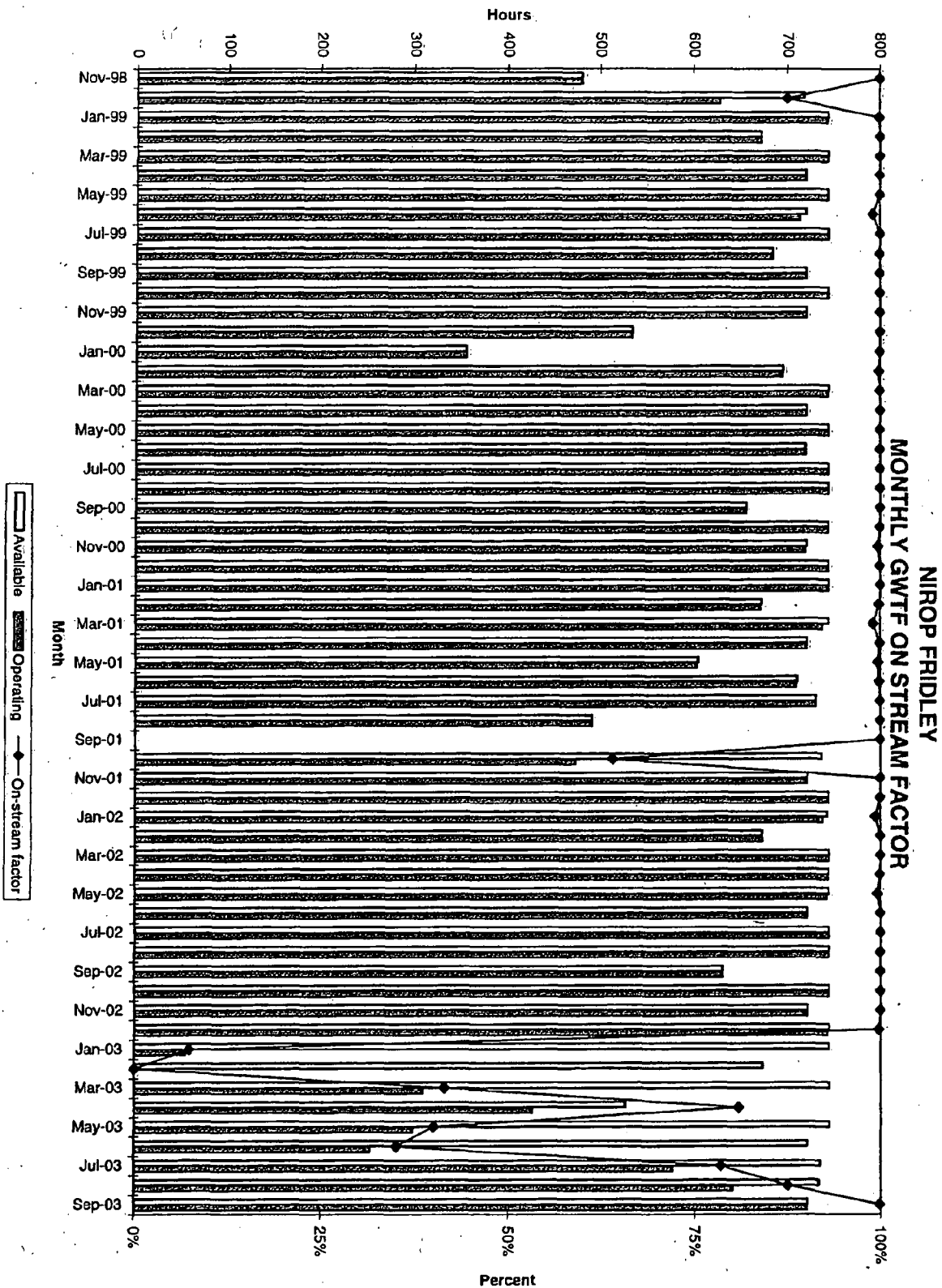


Figures

O&M Start Date: 11 November 1998

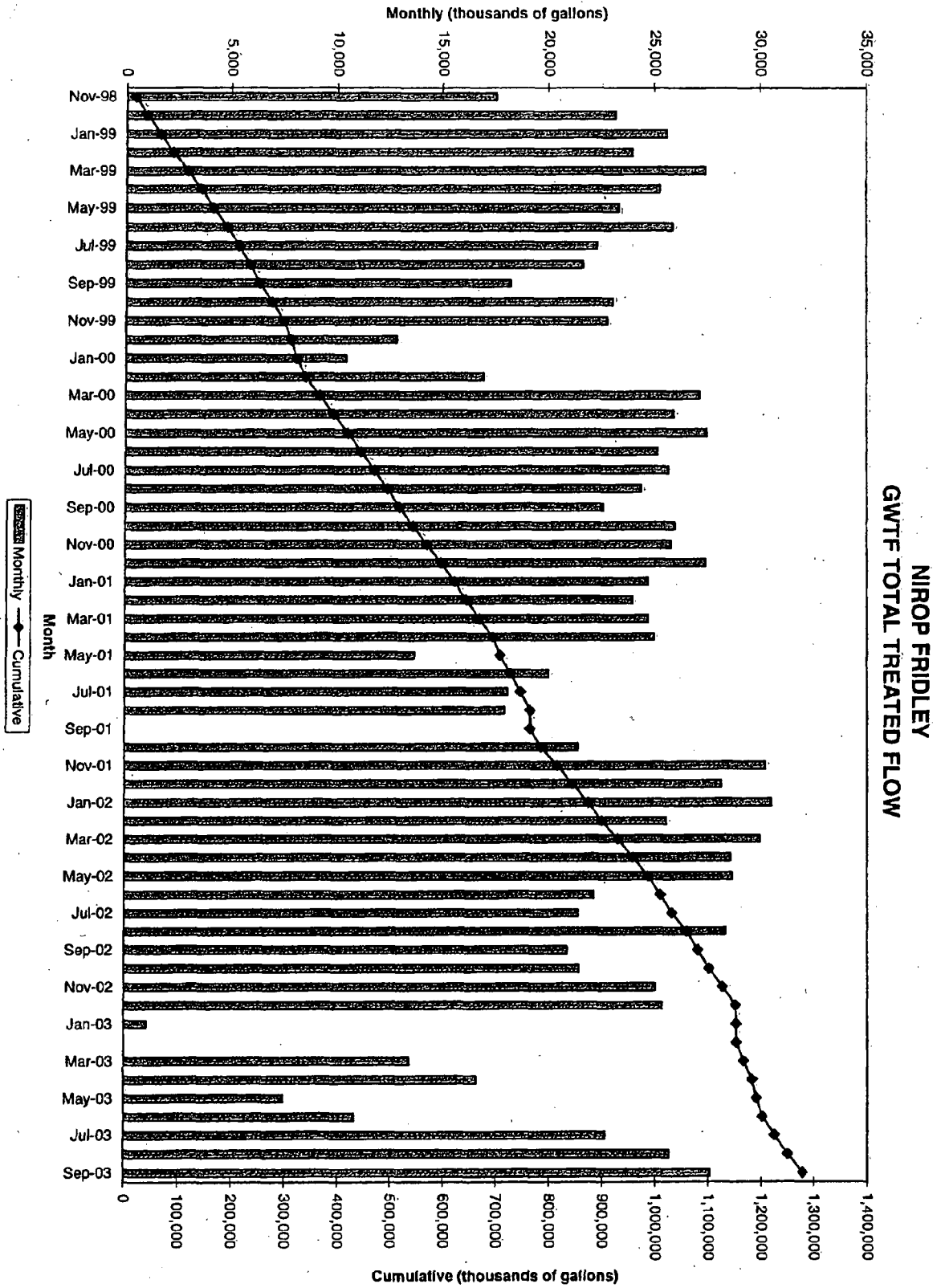
FIGURE 1

Available hours are 24 hours per day, less scheduled down time and power outages.



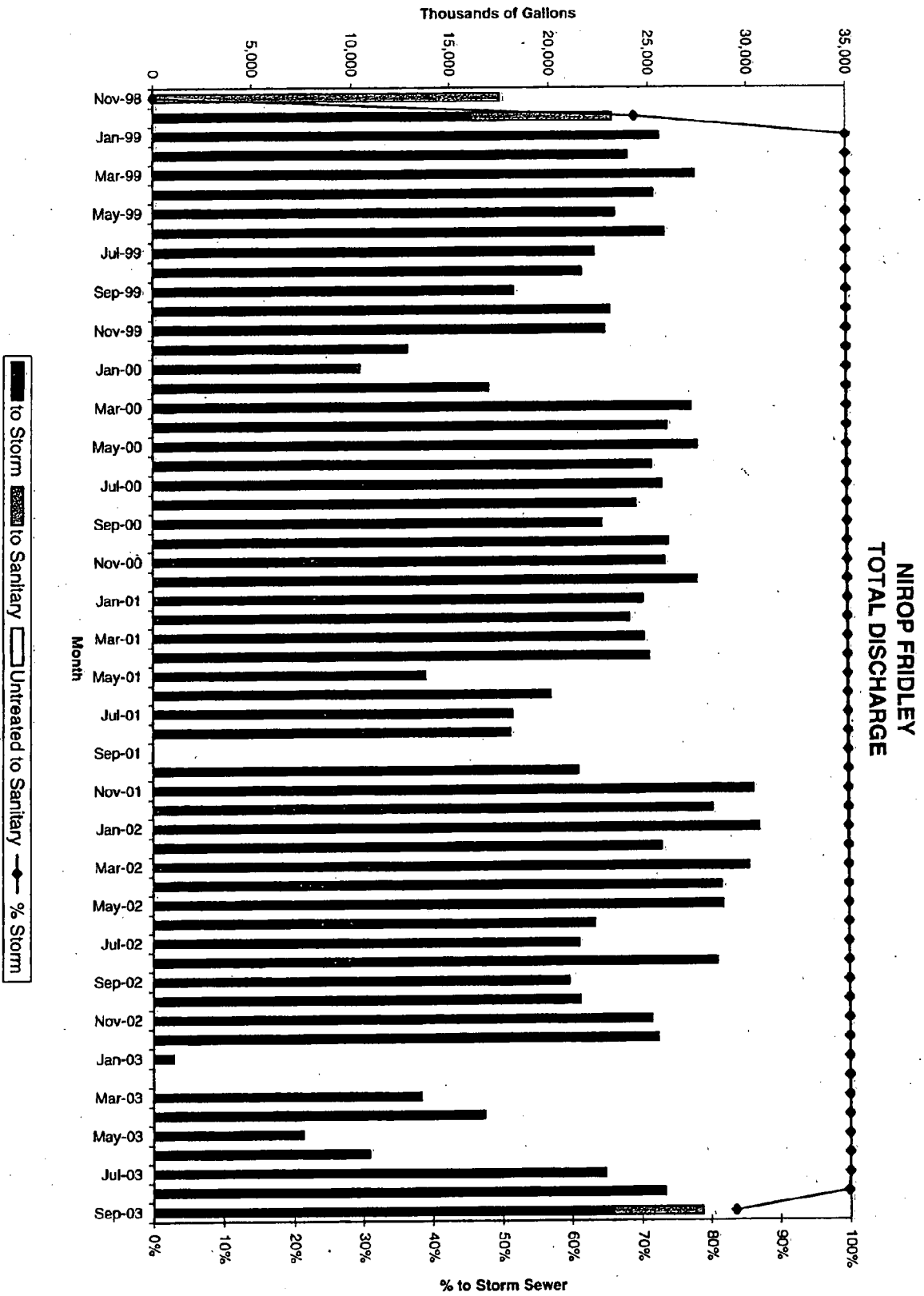
O&M Stat Date: 11 November 1998

FIGURE 2



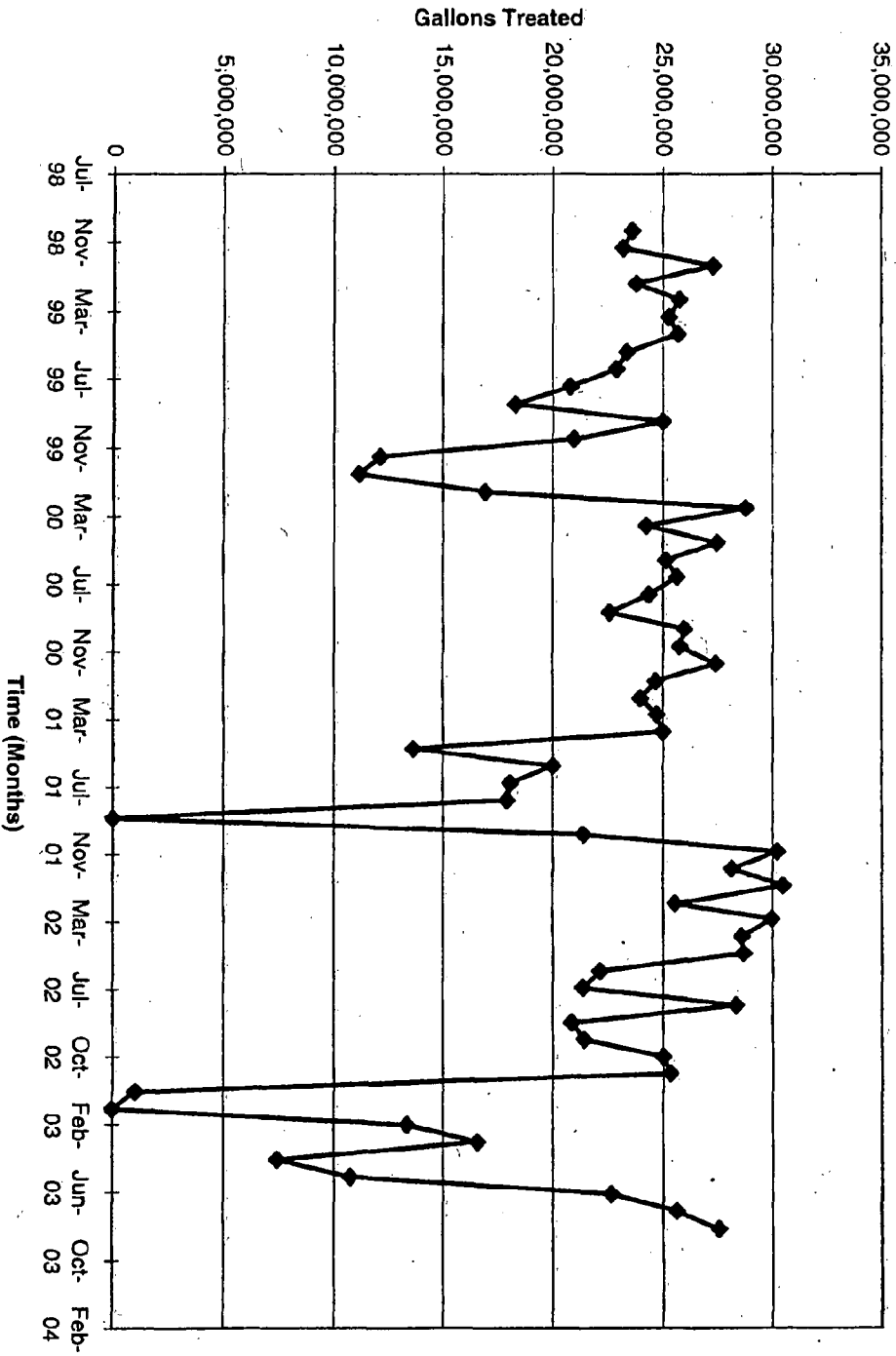
O&M Start Date: 11 November 1998

FIGURE 3



NiROP Fridley

Gallons Treated vs. Time



O&M Start Date: 11 November 1998

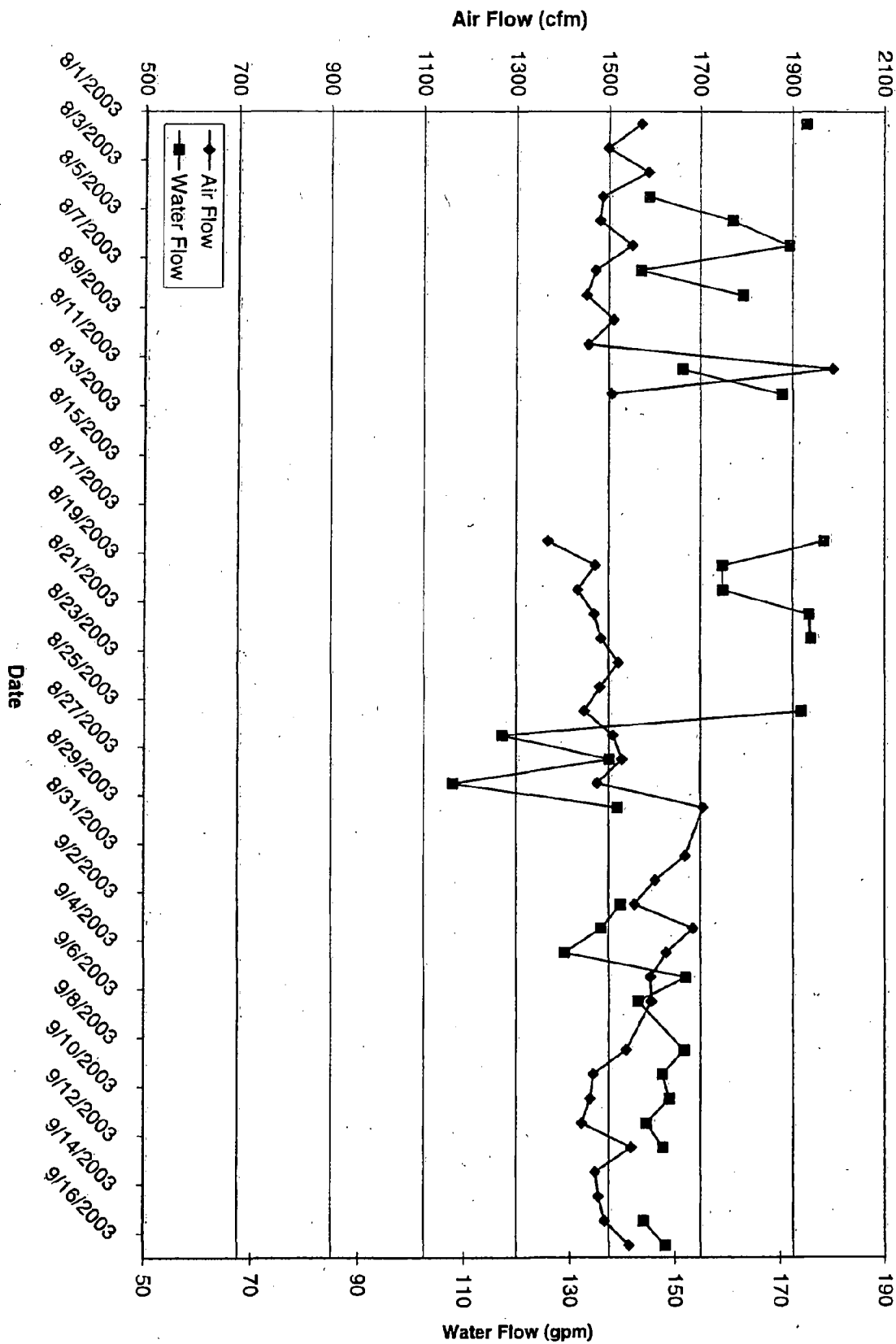
FIGURE 4



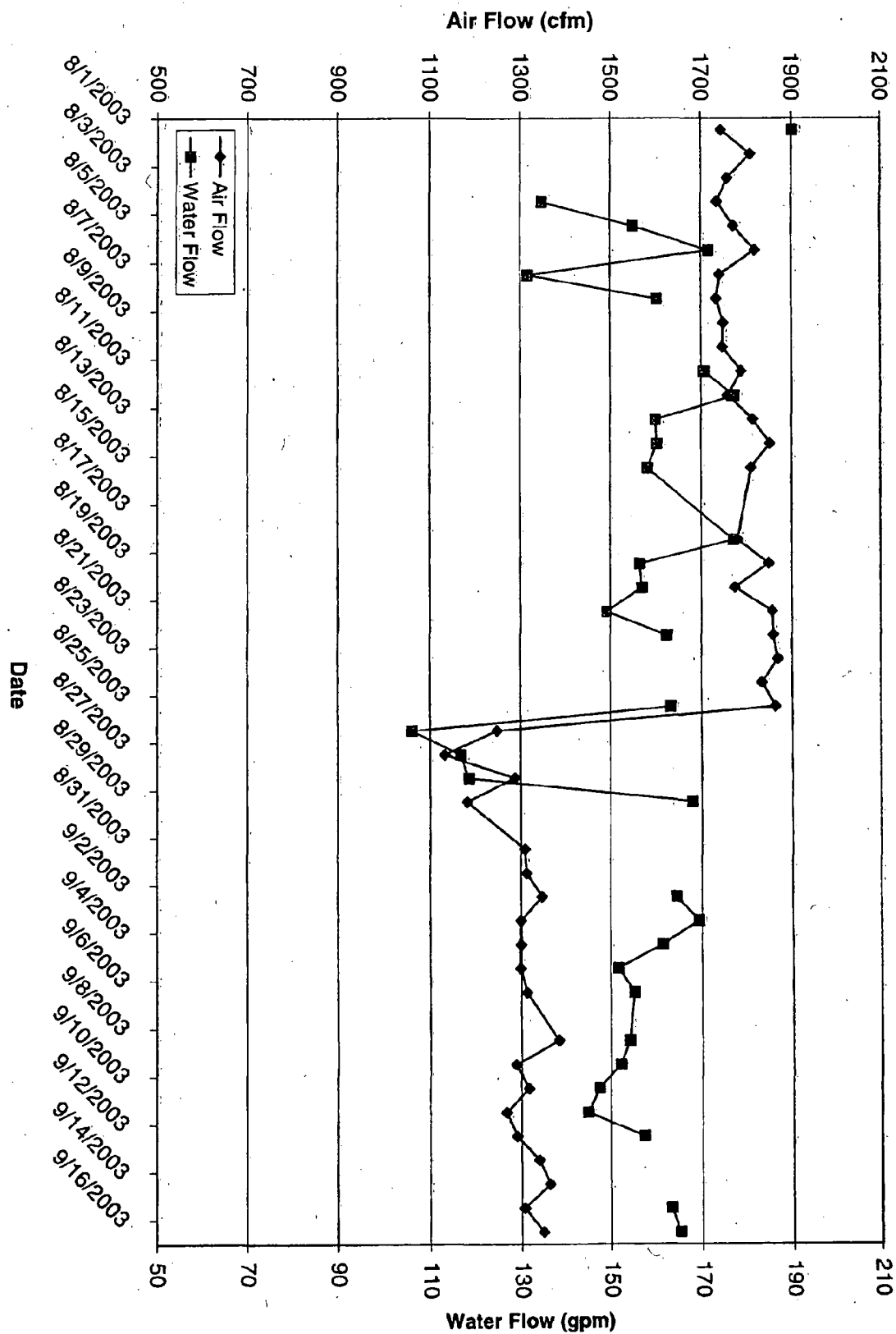
APPENDIX 1

**Air and Water Flow Rates
for
Air Stripper Units ASU-201 through ASU-204
8/1/03 through 9/16/03**

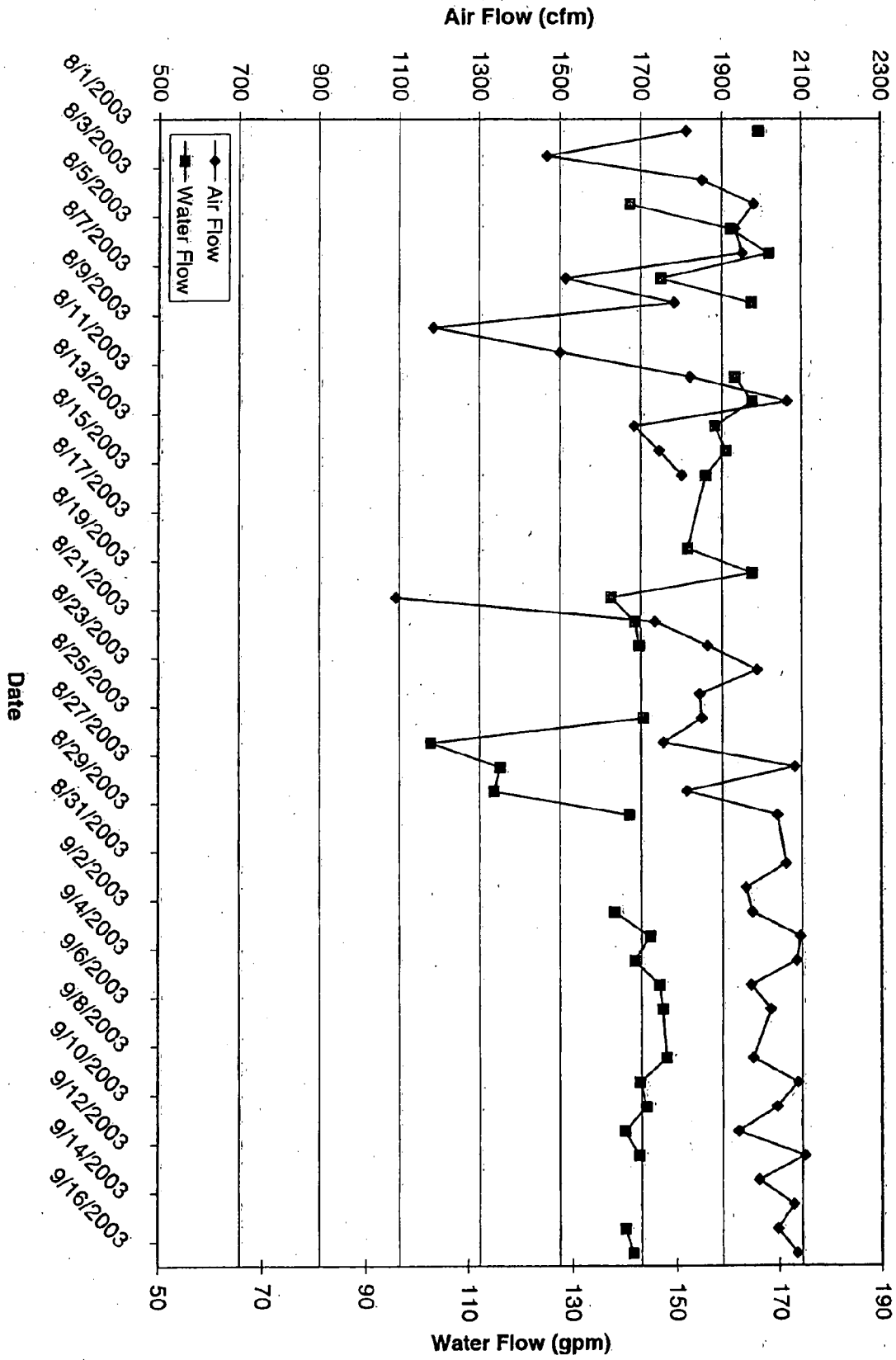
ASU-201



ASU-202



ASU-203



ASU-204

